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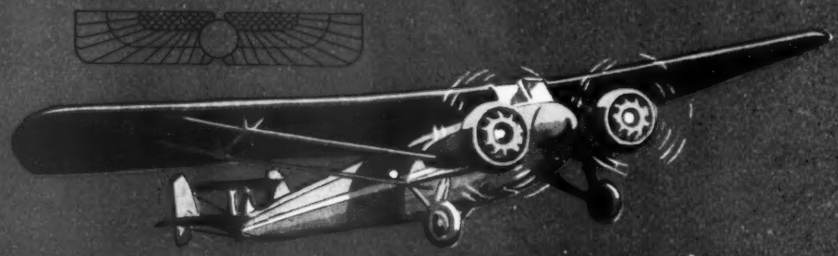
The Oldest American Aeronautical Magazine



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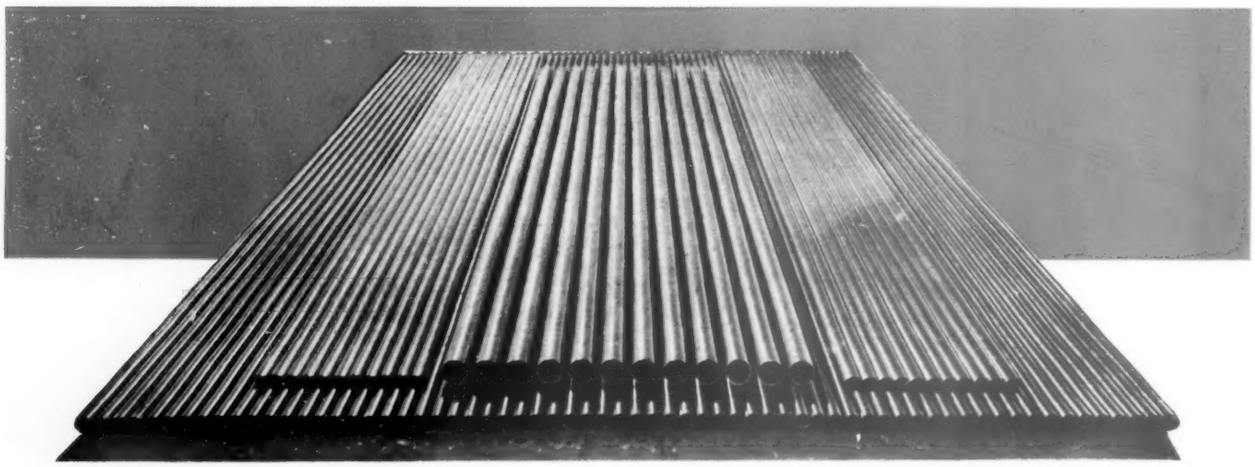

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AVIATION

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The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

LOUIS F. STOLL, *Publishing Director*

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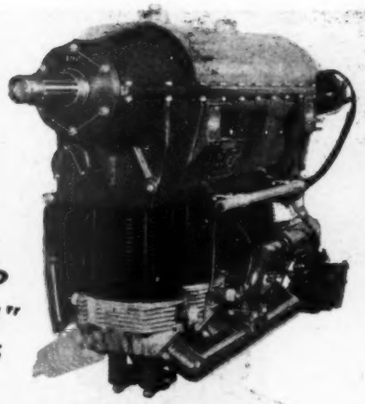

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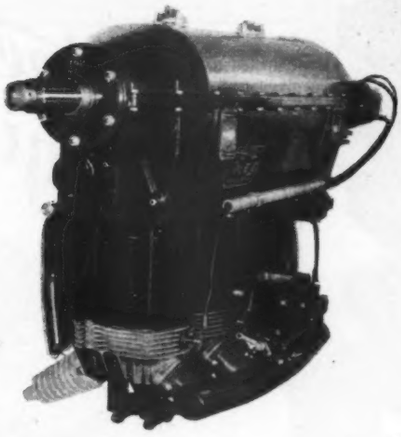

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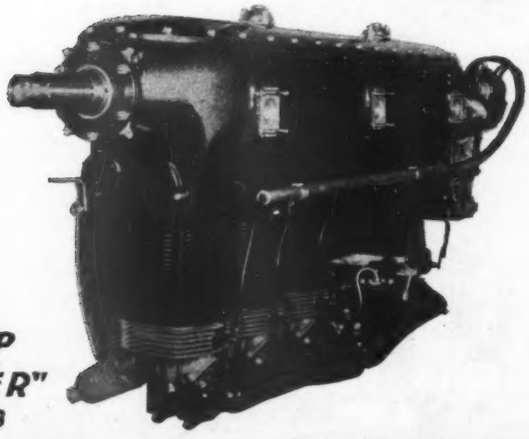

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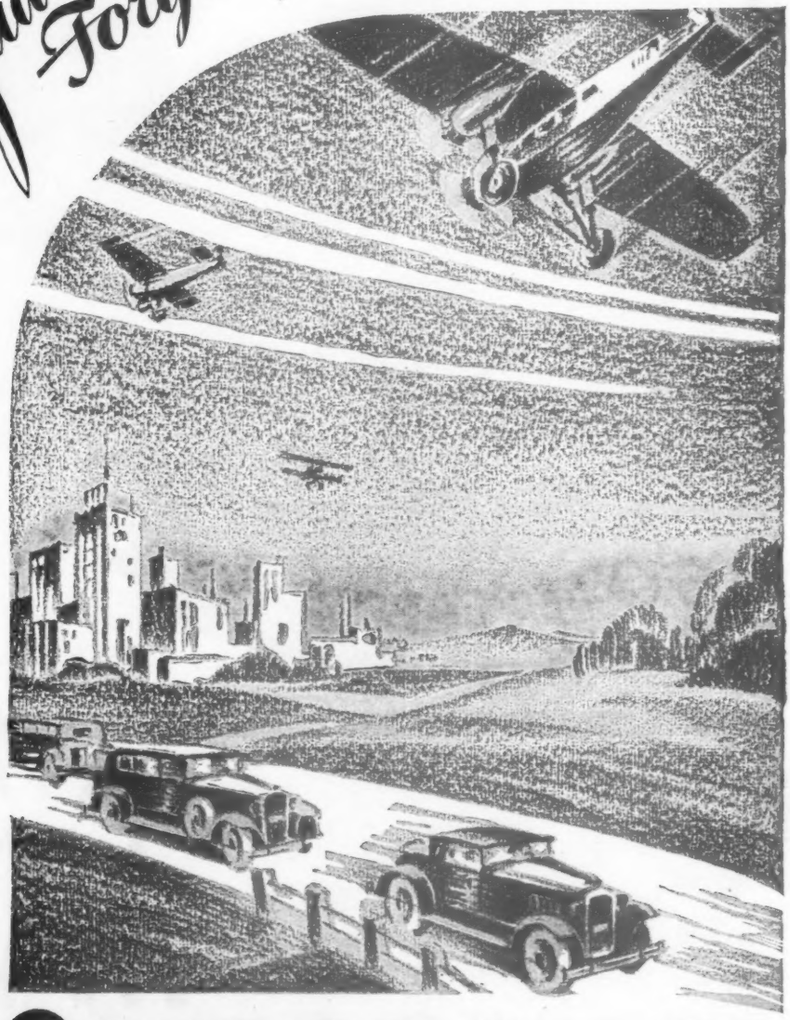

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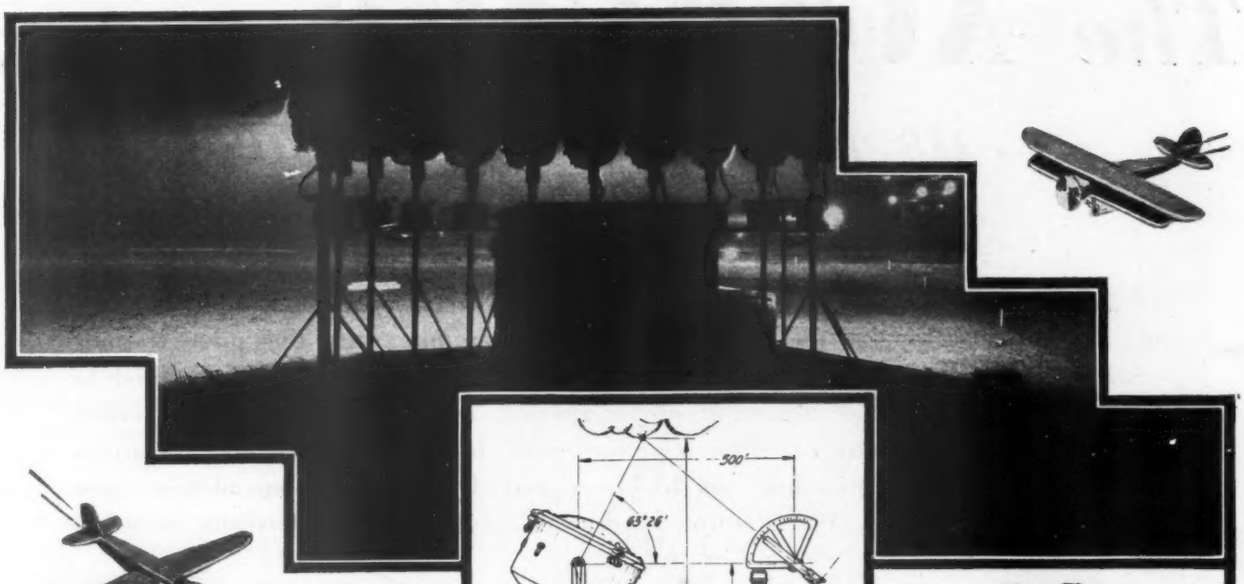

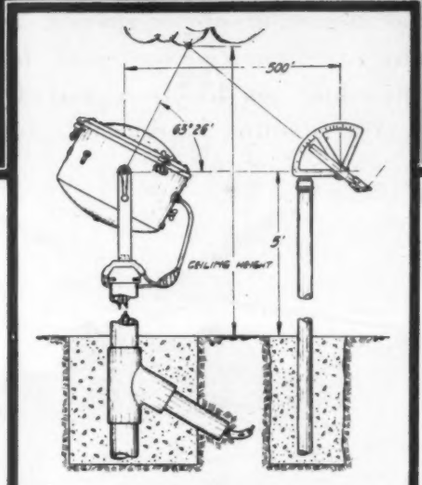

Right—*Ceiling projector and alidade for determining ceiling height.*

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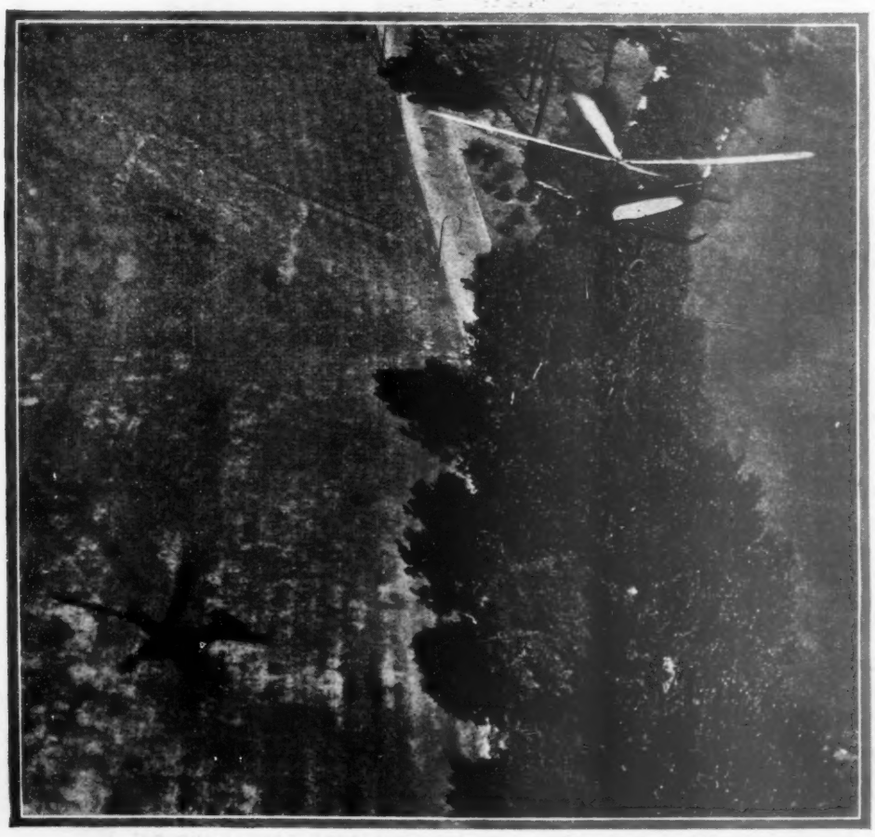
The AUTOGIRO

. . . its potentialities to the Airplane Industry

The inherent aerodynamic stability of the Autogiro, by permitting take-offs, landings and all normal flying maneuvers with *slow deliberation,* cuts the pilot training period at least in half and makes it entirely possible for the average individual to consider the operation and ownership of an aircraft, as he now owns and operates an automobile. The Autogiro eliminates the need for the lightning-like decisions that now put such a premium on highly expert flying skill. Dependence upon such skill is one of the great limiting barriers to growth of the airplane industry.

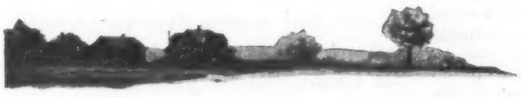


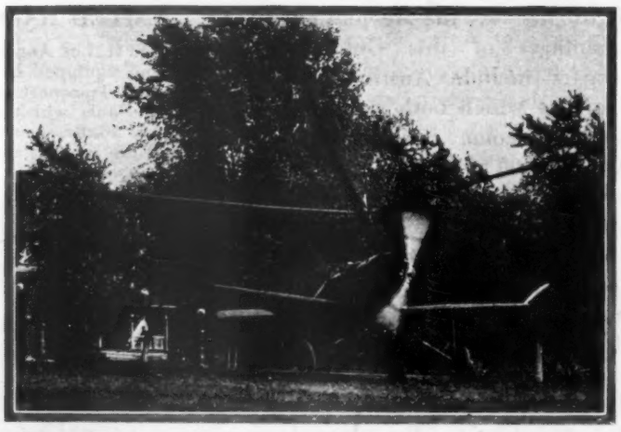
Above: After a short run of 30 to 40 yards, reaching a speed of about 25 miles per hour, an Autogiro can immediately assume an extraordinarily sharp angle of climb. In addition to the great practical value of its ability to utilize almost any open, level spot of ground, the inexperienced pilot or passenger is freed of his dislike and fear of the long, high-speed ground run, necessary for the average airplane.

At left: This photograph shows the Autogiro in slow flight. Note the shadow thrown by the craft. What would be a disturbing position for a plane of the conventional type, is freed from all danger by the ability of the Autogiro to fly with slow deliberation at speeds as low as 20 miles per hour or at speeds well over 100 miles per hour.

The Autogiro affords unusual maneuverability. It can turn in a remarkably short space and at low speeds, although capable of speeds well over 100 miles per hour. To the novice, this ability to turn without fear of loss of speed adds tremendous security. Furthermore, if he desires he can check his speed and let his Autogiro settle safely on any clear spot of ground.

Below: **Demonstrating the ability of the Autogiro in emergencies to check its speed and gently descend in front of any obstacle it cannot clear. An impossible performance for the conventional airplane. In normal landing, the Autogiro can check its own speed, deliberately choose its landing spot, hover for a moment and set itself on the ground with a jarless ease — with no forward speed at all. Probably the most amazing demonstration of the value of the Autogiro principle, and a tremendous relief to teacher and student of flying alike.**





Above: **The camera here caught the Autogiro just after it settled over the surrounding trees and a moment before its wheels touched. Autogiro performance frees the novice from the hazards of high-speed take-off and high-speed landing. Outstanding pilots agree that it will cut the time and cost of learning to fly more than half.**

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A MAMMOTH HANGAR

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At the United Airport near Los Angeles The Austin Company has recently completed one of the largest hangars on record . . . a structure 310 by 248 feet . . . capable of accommodating at one time five ships the size of the DO-X . . . or more than 25 of the largest tri-motored transport planes now in use.

Highlights of the revolutionary advantages of this Goliath of hangars include Austin Canopy Doors by which both sides of the hangar become two clear span openings 300 feet wide. Abundant daylighting results from steel sash windows in the doors and side walls . . . ship handling is expedited by clear floor areas . . . and tho permanently constructed of steel, brick and concrete, this hangar can easily be expanded in size as the need arises. It won't stop growing . . . the clear door openings may be increased indefinitely . . . from 300 to 3,000 feet . . . or even more if desired.

In their development of this superhangar, Austin's Airport Engineers only blazed further progress along a trail they have consistently pioneered. For with their thirteen years' experience in the aeronautical industry, they have acquired a degree of specialization and achievement that is extremely rare in this new industry.

Austin's airport experience has included the development of complete airports where nothing was before . . . as in the case of the United. Terminal facilities, hangars, schools, aeronautical factories and service structures were all provided under Austin's plan of Undivided Responsibility.

UNITED HANGAR NO. 3

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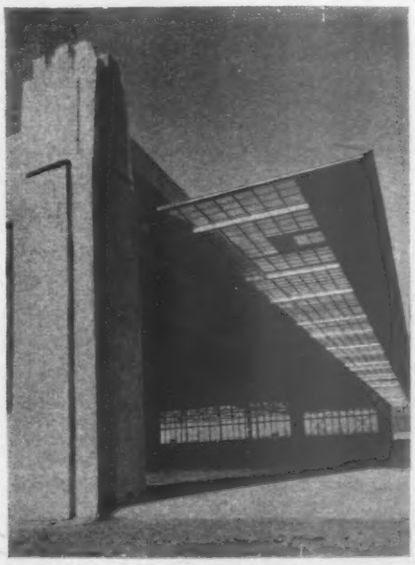

Under this plan the Austin organization assumes complete responsibility for all the elements entering into a project . . . site selection, survey, design, construction and equipment . . . separate responsibilities ordinarily . . . are welded by the Austin-Method into one integral service.

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The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

VOLUME 30 . . . *February, 1931* . . . NUMBER 2

EVERY HOUR ON THE HOUR

THE rule of frequent departures, inaugurated by the New York-Washington Airline and now to be emulated in the Middle West, has brought into air transport a change far more fundamental than is commonly realized. The running of an hourly plane does not merely increase the volume of operation. It does not merely diminish the relative overhead and so make it possible to lower rates, although that is quite important enough. It does more. It produces in the traveler a wholly new attitude of mind toward air transport.

There are six factors that have been responsible for an unsatisfactory volume of traffic up to the present time. Not all have operated in every case, but one or more always appear to some extent. There is the question of cost, still appreciably higher than by rail in most cases; the fear of mishap, a far less important deterrent now than two years ago; the realization that weather conditions sometimes make flying impossible, and that a scheduled arrival at a destination therefore cannot be absolutely counted upon; sheer failure to have acquired the habit of air travel, a very important factor and one which only time can overcome; discomfort to which the passenger is often subjected; and there is inconvenience.

Inconvenience plays no inconsiderable part in weaning passengers away from the airline. Airports are often difficult to reach. They are far away from the city, and transportation facilities are frequently unorganized. Accurate information on where fields are located, and where and how the airlines run is sometimes lacking. But most serious of all in effect upon the volume of traffic is the fact that schedules often appear to have been made in cheery disregard of the fact that air transportation is pre-eminently a service for the man in a hurry, and specifically for the man overtaken by emergency.

It takes five hours to go by train from New York to Washington. The man who cannot afford to spend that much time riding over the rails is, by the same token, a man who cannot afford to spend twelve hours or six or even two sitting around his office waiting upon the convenience of an airline schedule. He uses the airline because he wants to arrive in a hurry. Obviously, he wants to get under way without hesitation and delay.

There has been a great deal of talk, some of it in rather a pessimistic vein, about the natural limits on passenger air travel or the amount of traffic available for the passenger line. With rare exceptions there has been no serious attempt to find out how much traffic was available, and no possibility of finding out while existing schedules continue. We have in mind two southwestern cities 200 miles apart. The surface transportation connecting them is atrocious. There is an airline. Twice within the past few months a member of the editorial staff of AVIATION has had to travel from one to the other, and on neither occasion has he made the trip on the regular air service. Unfortunately, the plane starts at ten o'clock in the morning, and it was impossible to be ready to leave before two or three in the afternoon. However bad the alternative means of transport might be, they were preferable to waiting twenty hours, or until ten the next morning, for another chance at the airplane. When the operator of a transport line makes discouraged affirmation that there are, as shown by his experience, only three or four passengers available each day over the territory that he covers, he is entirely misinterpreting his own data. He has no basis for saying that there are only four people who want to fly. All that he can say is that there are only four who have been able to accommodate their desire to fly to the hour which he has more or less arbitrarily elected to start his flying.

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Let him put on another ship four or five hours earlier or later, and there should be another group of passengers, previously unheard from, for that one.

As a matter of fact, doubling or tripling the schedule should more than double or triple the traffic. There certainly are a considerable number of business men in America who after a few unfortunate experiences with schedules have come to the disgusted conclusion that air transport is no good because it never goes when it is wanted. Thereafter, even on those occasions on which the requirements of a particular trip do happen to blend with the schedule provided by the airline the fact is apt to be overlooked, because air transport has been dropped from mind into a limbo of supposed futility. There could be no greater aid to the development of the air traveling habit than to imbue those who must move about frequently and rapidly, and often on short notice, with the conviction that the airplanes are starting all the time. Instead of trying to force the passenger to fit his own needs to the airline's convenience, try fitting the schedule to the passenger's convenience.

That is now being done in a few cases, and it makes a veritable revolution in air transport. It marks the first serious attempt to take advantage of one of the airplane's greatest assets, heretofore wholly scorned; its divisibility into small units. With every previously existing vehicle of public transport, by land or by sea, high speed and comfort were to be attained only by very large size. No limited train offers accommodations for less than 150 passengers, and no fast ocean liner for less than four or five hundred. Only the airplane permits of offering speed, comfort, and safety to groups of six or eight. Only the airplane, therefore, can afford real frequency of schedule. Yet we have cast the opportunity to provide it lightly aside while we pursue the will-o'-the-wisp of the giant airplane, which no airline could afford to operate more than once or twice a day under present conditions. It will be time enough to look for 50-passenger airplanes when we have exploited traffic to the limit with smaller ships, and have exceeded their capacity. We shall not have exploited traffic to the limit until hourly departures have become standard practice.

PARK THE AIRPORT

AIRPORTS are the public's first point of contact with the airplane. Considering the public interest in aviation and the value to the industry of capitalizing upon it, it is surprising that there has been so little effort toward making the airport a recreation center.

Swan Island municipal airport, Portland, Oregon, is completely grassed to prevent dust and is surrounded by a paved highway with liberal parking areas for visitors who wish to observe the operations there. Oakland, Cal., has provided a surfaced parking area, adjoining the municipal field, for several thousand automobiles. The magnificent provision at Curtiss-Reynolds Field, Chicago, became familiar to every visitor to the Races of 1930. Many ports now have restaurants where one may watch field operations while *enjoying* a meal, not merely consuming one. The city of Burbank, Cal., is building a beautiful public park adjoining United Airport. Fairfax Field, Kansas City, is being elaborately landscaped.

Unfortunately, the examples cited above are not typical. All branches of the aircraft industry would profit by the sponsorship of a campaign to provide accommodations at airports for the general public. The quicker people become familiar with airplanes, the quicker they will ride in them. The more people ride in planes, the more they will buy either planes or regular transport. The industry's only direct road to the general public is via the airport. Make the airport sufficiently attractive and the public will come to the industry.

AERIAL EXPLORATION

IN the aviation industry's efforts to bring about widespread acceptance of the airplane one market has failed to receive the emphasis which its possibilities merit. Few people realize the vast importance and scope of the activities of commercial and scientific explorers. Headlines are devoted to the aerial explorations of Byrd and Wilkins, and we too swiftly conclude that exploration is an uncommon thing in these days, only engaged in for the purpose of flying over lands never before visited by man.

As a matter of fact, much of the most vital exploration is being done almost within arm's length of our centers of civilization. Every mineral prospector is an explorer. Every geological or archeological party is performing exploration work. There are literally hundreds of such parties constantly at work in various parts of the earth, and their programs could be speeded almost incalculably in many cases through judicious use of the airplane.

Much of the development of aviation in Canada and Alaska has been as an aid to prospectors and miners. The same is largely true in South Africa and Australia. Air travel gives the exploring party a maximum amount of time at the scene of their work, and a maximum degree of independence of their surroundings. They ought to be the easiest kind of customers.

Of equal importance with the commercial prospector, as an aircraft market is the scientific party studying the weather in remote parts of the globe, or seeking the history of lost races in the jungles of Africa, India, or Central America. The airplane can be of the greatest use in exploring such territories as Africa, Persia, the Malay Peninsula, the interior of Australia, and even parts of Nevada and New Mexico. The whole world would profit from the establishment of remote weather obser-

vation stations, supplied by airplane where no ground transport exists. Students of archeology can greatly enrich world culture by a wider use of the airplane for uncovering the secrets of dead civilizations. The commercial possibilities in prospecting for minerals with air transport are most alluring.

It is the task of the aviation industry to acquaint itself with the problems of its customers. Here is a concrete case. Here is a call to learn enough about all branches of the "exploration industry" so that we shall really know where and how it can apply planes advantageously. In so doing we shall open the way to sell a good number of planes to be put to work where they will do good at once for aviation and for mankind in general.

The statistical pages which have customarily followed immediately after the news are omitted from this number of AVIATION. Their normal content, with a great amount of other material, will be included in the annual statistical issue, to appear next month. In March we shall present the same type of material given in the statistical issue of March 22, 1930, but brought up to date and improved in form of presentation, and supplemented by much that is entirely new. It is suggested that orders for extra copies should be placed in advance, as no large stock is carried on hand after publication.

GLIDER REGULATION

THE thread that suspends the sword of Damocles has been renewed. The builders of motorless aircraft have been given another six months before the axe is to fall. The date upon which an application for a glider license must be accompanied by stress analyses and kindred engineering data has been postponed to July 1, 1931. Still a postponement is only a postponement, and a threat, even though moved into the future, remains a threat.

We sincerely sympathize with the Department of Commerce in the dilemma into which it has been thrust, but it is impossible to avoid feeling compassion for the amateur builder of gliders, confronted with an ultimate rigorous application of the Air Commerce regulations.

If the federal law were the only one that had to be considered, there would be no problem. The Air Commerce Act applies only to aircraft used in interstate commerce, and the number of gliders so employed is, to put it conservatively, small. However, fortunately from many points of view but unfortunately from this one, a number of states have laws of their own which provide that there must be federal licenses upon all aircraft operating within the state. A glider is an aircraft. Hence the prospect that in those states every glider will have to go through all the rigmarole of stress analysis to Washington and of flight test that is prerequisite for an A.T.C. or a Group II approval on an airplane. Hence, especially, the theoretical necessity of inspection by a representative of the Department of Commerce, or, under a very recent amendment to the rules, by a licensed airplane mechanic, after any damage has been repaired and before the glider can be flown. We say "theoretical," for in practice few if any glider operators pay any attention to that stipulation, and we venture the prophecy that few of them will be prosecuted for disregarding it. In fact, there even now exists in some states a sort of armistice between the glider operators and the state law enforcement officials, under the unwritten terms of which all law affecting gliders is being ignored, and the machines have been built without inspection and flown on identification numbers in open defiance of statute.

Worse than any possible result of federal action, is the possibility of independent state regulation. One state has already made a rule that every glider must be built by a licensed airplane mechanic, and is collecting license fees of $15 on every glider and $10 on every pilot.

For solution of the problem, and simplification of the relation between the glider and the government there seems to be three possibilities. First, all states which now definitely require a federal license for all aircraft and operators might amend their law to exclude the glider. That would probably take about seventeen years, and even then it wouldn't be done everywhere, as the glider interest is too small to get legislatures really stirred up about it. Second, the Department of Commerce might very much simplify the requirements for glider licenses, making the visual inspection plan without submission of stress analysis permanent instead of temporary and abandoning all physical requirements for pilot's licenses. That would be definitely objectionable, for the Department ought to issue some kind of a certificate that implies a guarantee of the quality of design and construction. The manufacturer of gliders ought to be able to meet all the existing stipulations, and receive an A.T.C. and licenses as a sort of sterling mark for his product.

Then there is a third possibility. The word "license" as applied to aircraft and airmen has become sacrosanct through specific inclusion in state and federal statutes. Be is so. But create two grades of glider licenses. There certainly is no legal bar to, and we can see no very serious practical difficulty in, the issuance of class A and class B certificates. Let the former carry all the dignity of an airplane license and be based on an A.T.C. acquired with all due formality, but let there be a second grade, a license granted directly after visual inspection of the finished product. Let specific exception be made for gliders under the rule covering repairs, subjecting them only to general stipulations that the repair shall follow the original design, and that any glider may be grounded at any time by any state or federal inspector.

The timid, or those who have not followed the record of glider mishaps over the past year, may suspect us of paving the way for a holocaust of young lives. As a matter of fact, not one glider accident in five has had anything to do with the structure of the glider. Machines have been flown that would have been grounded upon the most casual glance by an inspector, that were obviously defective in every detail, and the work of artisans who had no idea of what aircraft construction was like, and still they have miraculously escaped accident as long as they have been handled with some slight discretion. The 80 per cent, or more, of glider accidents that are not attributable to design and construction of the machine are directly due to over-ambitious attempts by the inexperienced, or to attempt things that the slightest measure of common sense should have prohibited. The department's technique in handling glider student permits is admirable. The most important safety measure that can be taken in glider operation is a general insistence that novices should train and practice only under the supervision of some competent person—and his competence should be moral rather than physical. A reasonable measure of good judgment and a very large amount of discretion are the teacher's most important qualifications.

State legislation has made for the Department of Commerce an issue in the glider field which the Department never invited. The issue now exists, and only the Department can lead the way toward permitting a reasonable use of gliders without undue formality and without having the machines tied up much of the time waiting for the visits of inspectors. As a promising means of escape from present and prospective embarrassments, the dual license plan is urged upon their consideration.

AIR MAIL FOR OVERSEAS AMERICA

DURING the past two and a half years, American air mail operations have increased from 25,000 to 75,000 miles scheduled daily. Three transcontinental services have been supplied. South America has been surrounded, and Central America and the Carribean have been interlaced, with the travels of American commercial planes, and yet not a single one of the territories of the United States beyond its continental boundaries, save only Porto Rico and the Canal Zone, have been given the benefit of government-supported air service.

Look to the Pacific. The Hawaiian group of islands spreads out over a thousand miles. Omitting those that are completely isolated and nearly or quite unpopulated, there are five islands of real commercial importance, and they run 300 miles from Kauai in the West to Hawaii in the East. Two or three times a week the various members of the group are served by little steamers, plodding along at ten or twelve miles an hour. From Honolulu to Hilo, the two most important cities of the territory, is an all-night voyage. By air it takes two or three hours. There have been sundry attempts to maintain an air service, but, like air transport operations elsewhere, they have faced a formidable financial problem. The Postmaster General is empowered by law to contract for air mail service among the islands, offering terms that will make it worth while to secure good equipment and maintain a good ground organization. A contract ought to be awarded—forthwith.

The case of Hawaii is good, but there is a still better one nearer home. Off to the northwest of the United States, reaching an arm down along the coast of British Columbia for several hundred miles toward Puget Sound, is Alaska, once derided as "Seward's folly" because that statesman was so reckless as to expend $7,000,000 on its purchase. The territory has become one of our greatest fisheries, one of our greatest potential reservoirs of mineral wealth, and an export trade of $60,000,000 annually. Our total volume of commerce with the territory exceeds our trade with Peru, Uruguay, or Venezuela.

Alaska is even worse equipped with surface transport than is Hawaii. A railroad runs from Seward up to Fairbanks, with a few short spurs elsewhere, and steamers work their way in and out among the islands along the coast. Flying conditions, over much of the country and through much of the year, are by no means difficult. A start has been made through years of operation by the late Ben Eielson and Noel Wien and the Alaska-Washington Airways and others, to say nothing of the Army and Navy. Quite as definitely as Central America or south central Asia, this territory depends upon transportation for its future and for the exploitation of its wealth. The Weather Bureau is planning to spend $24,000 there, and $32,000 in Hawaii, on aeronautical meteorological service during the coming year. Again, the Postmaster General has it in his power to give contracts and to start mail routes to operating. Again, why not?

We do not underestimate the importance of maintaining air communication with foreign countries. The benefits are both political and economic, but let us not so stress them as to overlook entirely the case for our own territories. For the coming year we are to spend $27,000,000 in providing air mail service at home and abroad. One hundred and fifty thousand dollars in Hawaii and $300,000 in Alaska, less than two per cent of the total sum, would maintain regular services of the greatest economic importance.

Semi-Annual Index

THE semi-annual index of AVIATION for Volume 29 (July to December, 1930) is now ready. Copies may be secured by writing to the Circulation Department, AVIATION, 36th Street and Tenth Avenue, New York City.

News of the Month

NEW AIRLINE SCHEDULES

HOURLY passenger service at minimum rates, approximating those of the railroads, is planned for the middle west for the coming summer. Plans have been announced for a group of lines, with the same general characteristics as the New York-Philadelphia and Washington Airway, to link Lincoln, Detroit, Chicago, Cleveland, and probably St. Louis, Kansas City, and various other cities. E. L. Cord, youthful prodigy of the automotive industry and controlling factor in the Stinson and Lycoming companies, appears to be the moving spirit in the new plan, and Lycoming-powered Stinson tri-engined planes will be used. One hundred planes are reported to have been ordered, and the plan is to start service on March 9.

In the meantime, some additions to existing schedules are being made. Eastern Air Transport extended its passenger service from Atlanta to Miami on Jan. 1, leaving Atlanta daily at 9:15 a.m. and reaching Miami at 4:45 p.m., with a stop at Jacksonville. The return trip is also made by day, and bi-engined Curtiss Kingbirds are being used. Within the next two months Eastern Air Transport expects to supplement its existing service over the inland routes of the South by operation on a coastal airway straight down the costal plain from Richmond to Jacksonville.

Not all of the new activity has been in the South. In spite of winter weather, a new company, to be known as Tri-State Airways, has opened passenger operations between Detroit and Chicago, replacing the Stout Air Line service, recently suspended by National Air Transport when it absorbed the Stout company. The Tri-State line schedules two trips a day in each direction and is now using Stinson Juniors, but with a plan to put Lockheeds into service shortly. The only intermediate stop is in South Bend, home of the Bendix Corporation and of Knute Rockne football, and the fare from Detroit to Chicago is $15.00, or just over 6c. a passenger-mile.

Chicago has another new air passenger service provided by National Air Transport, running from the Illinois metropolis to Kansas City. Tri-engined Fords were put into operation carrying passengers on Jan. 2, the westbound run being made in the morning and the eastbound in the afternoon. At the same time the N.A.T. route to the southwest was changed to omit St. Joseph, Mo., flying from Moline, Ill., to Kansas City without stop.

Another change in schedule took effect just before the first of the year on Transcontinental and Western Air, and further reduced the importance of the air-rail combination in transcontinental service as compared with the straight through air service. Passengers leaving New York on Monday evening by train, for example, will henceforth fly only from Columbus to Tulsa on Tuesday, and on Wednesday noon will board at Amarillo the same plane for the west that they would have secured if they had flown straight through from New York to Kansas City, leaving Tuesday morning. The second section that used to go through for the express benefit of the air-rail passengers, delivering them in Los Angeles at half past three in the afternoon, has been cancelled and there will be only one daily service west of Amarillo.

RATE REVISION AND TRAFFIC

ALTHOUGH there has been no such sensational rate-cutting as marked the winter months of 1929-30, modest reductions have been made on the lines owned by or subsidiary to United Aircraft and Transport Corporation. All of their operations, including the Boeing, National Air Transport, Pacific Air Transport and Varney lines will henceforth charge 8.3c. per passenger-mile, a reduction of about 15 per cent from the former average. The fare from New York to San Francisco by N.A.T. and Boeing is now $227.50, having been $259.50 before Jan. 1.

Even without the aid of violent fare reductions, very satisfactory passenger traffic is being reported. The New York, Philadelphia, and Washington Airway, or Ludington Line, announces 17,106 passengers in four months, an average of 140 per day. A total of 2,150 trips have been completed. Most encouraging are the returns for December, following on a reduction in round trip fares, for in spite of the generally bad weather during that month 4,125 passengers were carried, and a one-day record of 266 passengers was made on the day before Christmas.

The Christmas holidays also produced a new record on the West Coast, 90 passengers traveling between Los Angeles and San Francisco on the Transcontinental and Western Air planes in a single day.

Airlines continue to display resentment over the necessity of paying a tax on the fuel that they use in order to support State Highway programs. The Boeing Air Transport Company has petitioned the federal district court in Wyoming for an injunction to prevent the state authorities from collecting a tax on fuel used in Boeing planes, alleging it an unwarrantable interference with interstate commerce.

AIR MAIL TO CANADA

THE Post Office Department has been active in extending air mail service to the north. On Feb. 2 the Chicago-St. Paul mail route of Northwest Airways will be extended through North Dakota as far as Pembina, a mile south of the Canadian border. The new extension is approximately 300 mi. in length. Connection will be made at Pembina with a Canadian air mail service from that city to Winnipeg, to be opened at the same time. The westbound service will leave Chicago at 11:30 p.m. and permit delivery in Winnipeg at 1 the next afternoon, while the eastbound plane will leave Winnipeg at 9:15 in the morning and arrive in Chicago at 7:15 the same evening.

The new route is the result of negotiations carried on by Assistant Postmaster-General W. Irving Glover with P. T. Coolican, who holds a position in the Canadian Post Office Department corresponding to Mr. Glover's own. The Canadian air mail service has been

Calendar

March 25-27	Third National Conference, Airport Section, Aeronautical Chamber of Commerce, Mayo Hotel, Tulsa, Okla.
April 11-19	All-American Aircraft Exposition, City Airport Hangar, Detroit.
May 15-31	International Aero Exhibition, Stockholm.
Aug. 27 Sep. 7	(Tentative dates) National Air Races, Cleveland Municipal Airport.
September	(Tentative) National Air Tour.
Early Autumn	Schneider Trophy Contest, England.

expanding rapidly, especially in the northwest, and commenting on the significance of the new connection, Mr. Glover pointed out that it completed an uninterrupted line of air mail service over a distance of about 11,000 mi., from Iklavik in the Canadian Yukon to Buenos Aires. Mr. Glover further forecast the development of an aerial trade route across Canada and Alaska and over Behring Strait, and thence across Siberia to Southeastern Asia or Western Europe. A despatch from the Moscow correspondent of the New York *Times* announces that the Soviet government is definitely planning such a service on its own account, as an incident to a general consolidation and extension of Russian airlines. They will be brought under the direct control of the Department of Labor and Defense.

AIR MAIL AT HOME

IN THE meantime the prospect that the Canadian government might develop air mail service through western Canada and parallel to the southern border of the country, from Winnipeg to Vancouver, intensified the resentment displayed in the northwestern United States over the failure to provide a northern trans-continental air mail service through the United States. Notwithstanding the fact that the company attacked has some of its most important operations centered in his own state, Senator Dill of Washington assailed the Post Office Department's policy and accused the United Aircraft and Transport Corporation of having approached monopoly, with the connivance of the Post Office Department. He introduced a resolution in the Senate calling on the Postmaster General for a large quantity of data relative to existing air mail services and the companies that operate them. Such a resolution would be the natural prelude to a Senate investigation, but no immediate action was taken upon it and it seems unlikely to pass. Senator Dill had previously succeeded in getting the Post-Office appropriation bill amended in the Senate to provide for the northern route, but the House has so far refused to accept the amendment.

The Post Office Department's plans and policies in developing the air mail came in for some rough treatment from the Postal Sub-Committee of the House of Representatives Committee on Appropriations during the preliminary hearings on the Post Office budget for the coming fiscal year. Representative Wood of Illinois, chairman of the appropriations committee, was especially severe in his strictures. However, the committee reported the bill to the House of Representatives and it passed the House with the full amount that had ben allowed by the Bureau of the Budget, $20,000,000 for domestic air mail service and $7,000,000 for foreign air mail. These figures compare with $15,000,000 and $4,300,000, respectively, provided during the present fiscal year.

During his testimony before the committee, Mr. Glover explained that only six new domestic routes, totalling just under 3,000 mi. in length, were planned for the fiscal year 1932. He also made a comparison of the rates of payment on contracts on the old poundage basis and on the new basis provided by the Watres act. For the month of August, taken as typical, the largest gainers would have been the Chicago-Atlanta route, on which the payment would have been increased from $9,443 to $50,792, and the Bay City-Chicago run of Thompson Air Lines, with an increase from $15,895 to $41,604. By far the heaviest loser would be Western Air Express, whose compensation for the Salt Lake-San Diego service for August would drop from $216,078 on the old system to $97,282 on the new. The net result of the conversion on all routes would be a decrease of about 4 per cent in the amount paid for the existing services. At the present time the conversion to the space-mile basis has been made on all routes on which it is legally possible. Holders of contracts under the old law cannot be changed over to the new one until they have been running for at least two years, and there are a few that have not yet met that condition.

AIR MAIL ACROSS THE ATLANTIC

THE Post Office Department's scheme for trans-Atlantic air mail has continued to attract newspaper attention, but there has been no evidence of definite progress during the month. Owing to a technical error in the wording of the advertisement for bids on such a service which had been issued by the Post Office Department, the call to submit bids to be opened on Dec. 29 was withdrawn. Early readvertisement is, however, planned.

The British government seems to be comparatively uninterested in the trans-Atlantic proposal, and the London *Times* observes that unless some very active measures are taken immediately "it seems certain that the United States and probably France will start a trans-Atlantic service before two years have elapsed, while Great Britain will not have made a beginning."

Air mail service to foreign countries also came in for severe criticism during the hearings of the House Appropriation Committee. The Senate amended the bill to increase the amount provided from $7,000,000 to $7,345,000, for the express purpose of supporting a second mail service from the United States to Mexico City, running down to the interior of the country from El Paso, but the amendment was dropped out in conference between the Senate and the House.

The Mexican Aviation Company, a Pan-American subsidiary, has in the meantime announced a general 20 per cent reduction in fares on its routes, bringing the fare from Mexico City to Brownsville down to $70. During 1930 the Mexican Aviation Company has carried 10,553 passengers and 280 tons of mail, baggage and express, and flown 660,000 mi. The amount of flying increased some 25 per cent over 1929, the volume of traffic almost 50 per cent. During the same year, the Corporacion Aeronautica de Transportes, the prospective beneficiary of the new mail contract for which the Senate attempted to provide, flew 1,250,000 mi. entirely without mishap.

Another American company is also showing renewed interest in Mexico. Pickwick Airways have sought from the Mexican government permission to resume operation on the Los Angeles-Mexico City and Mexico City-Guatemala City lines on which they suspended activities several months ago.

Activity in the Caribbean area of course increases during the winter months, and an important event of the closing days of 1930 was the opening to passenger travel of the direct service between Miami and the Canal Zone, including a non-stop flight of 662 mi. between Cristobal, Canal Zone, and Kingston, Jamaica. The route had been opened with mail a few weeks earlier. The Pan-American company has 30 planes based at Miami for the winter tourist traffic.

THE ITALY-BRAZIL SQUADRON

WITHIN a few weeks after the delivery of the first American air mail in Rio de Janeiro by Pan-American Airways, Brazil was reached by air by a squadron from Europe. The spectacular voyage of the squadron of twin-hulled Savoia flying boats, although unhappily marred by two crashes and the death of five members of the expedition during and immediately after the take-off in Western Africa, was carried through brilliantly after the squadron was once well in flight. Of the fourteen planes which started from Rome, ten arrived at the Brazilian coast, flying in formation under the command of General Italo Balbo, the Italian Air Minister. Of the remainder, two crashed in taking off for the trans-Atlantic section, as already noted, and two had forced landings at sea, near Fernando da Noronha, without damage.

Preparations for the flight had gone on for a number of months, a preliminary survey trip having been made as far as Bolama, the point of take-off for the Atlantic flight, to test the take-off conditions existing there and determine the load with which one of the Savoia planes could be put into the air.

The machines used differed from the Savoia boats previously seen in having twin Fiat geared engines of 560 hp. each. The engines were run on a mixture of gasoline and benzol, and each

boat carried 1,430 gal. of fuel, taking off with a full-load weight of 22,000 lb. and a wing loading of 22 lb. per sq.ft. The maximum speed of the boats at full load was 105 m.p.h.

The longest single stage of the flight was 1,880 mi., from Bolama in Portuguese West Africa to Natal in Brazil. The cruising radius in still air was calculated as 2,200 mi. A crew of four was carried in each plane, two pilots, a radio man and a mechanic, and one of the pilots was designated as navigator. Although the machines flew in formation throughout, each one was equipped to navigate independently. [For the foregoing technical information relating to the flight we are indebted to Commander Silvio Scaroni of the Italian Air Force, known to many Americans both for his reputation as a pilot and for his service as air attaché at the Italian Embassy in Washington from 1925 to 1929.]

The flight was aided and safeguarded by the use of two small station ships to serve as bases of supplies and floating hotels, and by the establishment of a cruiser patrol across the South Atlantic, similar to that which the United States Navy maintained on the North Atlantic during the NC trans-Atlantic flight in 1919. The squadron's actual departure from Italy was made on Dec. 17. Bolama was reached on Christmas day, Brazil, on Jan. 6, and Rio de Janeiro on Jan. 15.

It has been the general Italian policy to have long flights made by squadrons. Both in 1928 and in 1929 notable voyages in the Mediterranean were accomplished by large groups of planes. The United States Navy also put a squadron flight to its credit during the month, when a group of nine naval flying boats of the PN type made a non-stop voyage around the Hawaiian Islands. The flight, commanded by Commander Victor D. Herbster, a naval aviator since 1912, covered about 750 mi. and included seven islands in its circuit.

LATIN AMERICAN AIR TRANSPORT

NOT all of the Latin-American airlines in which American capital is interested make direct connection with the United States. A Latin American air transport company under home control, the Compañia Transportes Aereos Mexico-Cuba, which holds a concession from the Mexican government for a line between Mexico City and Havana, is purchasing Savoia twin-hulled flying boats from the American Aeronautical Corporation, the American licensee, to be put into service between Vera Cruz and Havana.

From South America there comes a report that the Peruvian Government has given a contract to the French Aeropostale company for the maintenance of air mail service (with the assistance of ships between Brazil and West Africa) between Peru and Europe. This, of course, will not interfere with American activities in Peru except that the American companies may lose a small amount of mail destined for European delivery, which they have heretofore been flying down to Chile or across the Andes to the east coast of South America and there delivering it to the Aeropostale line.

The Pan-American aero show and international congress planned for Montevideo in February has been called off because of lack of interest among prospective exhibitors.

AIRLINES ABROAD

ALTHOUGH the American industry has made no intensive effort to sell transport planes in Europe, contacts between our own industry and European operations are occasionally established. For example, the Danish government recently sanctioned service between Copenhagen and a number of provincial towns in Norway, to be maintained by the Danish Ford Motor Company and to make use of Ford planes. No definite date of starting operations has been announced. There has been no indication that the Ford-planned service will receive a government subsidy.

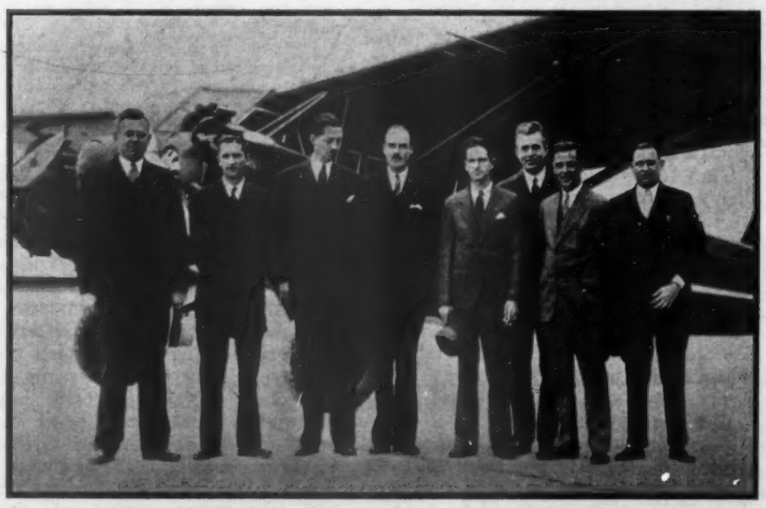
The most important airways developments of the month outside of the western hemisphere come from Asia, where all of the great European powers have plans underway, and where an individual American has recently played an important part. An air route across Siam is now being organized for early opening, with its termini at Rangoon, Burma, and Hanoi, Indo-China. It is interesting for two reasons. First, it completes the air transport network around the world, except for the stretches across the Atlantic and Pacific Oceans, for it makes connection at Rangoon with the Dutch line from Europe and at Hanoi with services to Hongkong and other Chinese ports. It is now possible to fly from Cherbourg to Shanghai and from Vancouver to New York. Second, the route has been laid out, the emergency fields prepared, and the equipment selected and the general plans made by Otto Praeger, second assistant postmaster general in charge of the United States Air Mail Service at the time when the service was started in 1918 and for some two years thereafter.

The report on the first three months of the Dutch Air Service from the Netherlands to the Dutch East Indies shows an average of about 400 lb. of mail on each trip. Planes are dispatched at fortnightly intervals.

Although the Dutch as yet hold the field in the extreme East, there has been steady progress on the lines from France to French Indo-China. The Air Orient Company is already operating in a small way in Indo-China, as well as between Marseilles and Bagdad. During January the services are being extended to cover the entire route from Paris to Saigon except the section across British India, on which arrangements aparently have not yet been completed with the Indian government. The Paris-Saigon course was flown, about two months ago, in a total elapsed time of 5 days, 3 hrs., 50 min., for 7,125 mi. Goulette and Lalouette were the pilots.

AIR NAVIGATION FACILITIES

IN the United States ground organization is still being steadily extended, and the Agricultural Department appropriation bill for 1932 passed the House of Representatives with an appropriation of $1,705,100 for aero-



Eastern Air Transport opens Atlanta-Miami section of New York-Miami passenger service on Jan. 1. Officials and guests of line at inauguration are (left to right): Capt. R. S. Westing, New York passenger traffic manager; T. P. Caldwell, southern division manager; Byron Freeland, Miami aviation board; George Cushing, Miami field manager and M. M. Philips, superintendant of mails.

logical work along airways, an increase of about $300,000 over the present fiscal year. Regular weather reporting is to be provided on several new routes after July 1.

Ground communications for relaying weather reports and other information are also to be extended in the near future, the Aeronautics Branch having just authorized the acquisition of another 2,524 mi. of teletype circuits, including 49 new stations. One new circuit will run from Pittsburgh to Washington, another from Seattle to Pasco, Wash., and a third from Los Angeles to Wichita.

The Department of Commerce is extending its mapping activities to the preparation of maps covering an area, to supplement the strip maps for specific airways that have so far been furnished. The United States is to be covered by 92 sectional maps, and the first, for the Chicago area, has just been issued. It spreads over a territory 329 mi. long and 153 mi. wide, with a scale of approximately 8 miles to an inch, and the general mapping conventions will of course be the same as on the familiar strip maps.

The Department's work for airway development is scheduled to receive $8,972,640 for the coming year, according to the appropriation bill as reported to the House of Representatives. That is an increase of 13 per cent over the present year's airway fund.

Work on a radio direction finder independent of the line marked out by the radio beacon, and always indicating the true course to be flown to reach an intended destination, has recently reached the stage of practical trial on a cross-country flight. The instrument has been developed by Mr. Godfrey G. Kruese, radio research engineer for Western Air Express, and includes a dial with a needle that points straight at any broadcasting station on which the receiver is tuned in. Successful demonstration has been made on a Los Angeles-San Francisco flight. The instrument not only indicates the course towards the station which is being received, but indicates also the time of arrival over the station, if it be at the destination of the flight, by a sudden vibration of the needle.

The Aeronautics Branch reports further airport progress. As of Dec. 31, it had recognized 1,782 municipal, commercial, intermediate, auxiliary, Army, Navy, private and state airports and landing fields—an increase of 125 over the 1,657 reported as of July 15. The December total includes 550 municipal, 564 commercial, 354 intermediate, and 240 auxiliary, and 74 Army, Navy, and miscellaneous.

California leads among the states, with a total of 165. Texas is second with 119, Pennsylvania third with 94. Alaska has the largest number of auxiliary fields, with a total of 63.

Allied with this report is the statement of the Hydrographic office of the Navy that as of Dec. 1 there existed 35 seaplane anchorages rated as Class 1, and 90 classified as having ordinary harbor facilities. Twenty-seven Class 1 bases are on the Atlantic Coast, two in the Gulf region, and six on the Pacific Coast.

AIRPORT ZONING

ANOTHER report issued by the Aeronautics Branch is that of its Committee on Airport Zoning and Eminent Domain, made public Jan. 5. This committee was set up to study ways and means of protecting transport operations from hazards which might be erected on land adjacent to public or semi-public airports. Need for special treatment of this problem arises from the feeling that to require public or semi-public airports to pay for contiguous land or rights in the air space immediately above it, in order to obtain safe avenues, would impose an undue burden upon an infant industry. It was recommended:

1. That, where not already covered and where political subdivisions other than municipalities are properly organized for the purpose, the provisions of state legislation be extended to include the adoption of zoning regulations by such political subdivisions as well as by municipalities.

2. That municipalities and other political subdivisions authorized to do so exercise the police power in the promulgation of properly co-ordinated zoning ordinances applying equitably to public airports and intermediate landing fields and to commercial airports of the public utility class, as well as other land uses.

3. That public airports and intermediate landing fields, together with commercial airports of the public utility class, be given the powers of eminent domain:

a. To condemn air rights over contiguous property in order to insure safe approaches to the landing area.

b. To condemn easements for the air marking of obstructions to air navigation jeopardizing the safety of the public in its use of the port.

c. To condemn contiguous property necessary for expansion of the port to meet public needs.

4. That, where not otherwise provided, appropriate steps be taken by public utilities commissions toward the protection of such airports and intermediate landing fields against the hazards of electrical supply and communication lines.

A progress report was issued in December by the Federal Committee on Airport Traffic Control. Though details have not been worked out, the system to be recommended will consist of a basic visual control complete in itself, with aural and/or radio equipment serving as an auxiliary. One instrument being studied is a portable signal projector operated manually and projecting a high intensity beam of narrow size, the beam being directed down a tube so as to be visible only to the plane at which it is aimed. This is provided with sights, trigger control and convenient means of changing quickly the color of the beams in accordance with the code worked out. Another instrument under consideration is a flashing signal-light unit, suitable for day and night use, to warn arriving planes that traffic at that particular airport is being controlled. Uniformity of control systems is, of course, one of the chief aims of the committee.

New field control regulations have been adopted at Oakland Municipal Airport without waiting for national standardization. The field is divided into sections by white lines drawn on its surface. Landing planes must come to a full stop before crossing the white line into the parking zone. They must also clear a safety landing line placed far enough from the highway over which landings are made to ensure clearing it at a safe altitude. Fueling and servicing zones have also been marked off and may not be used by taxiing aircraft.

AIRPORT IMPROVEMENTS

OUTSTANDING airport improvement programs include the award of a contract for filling approximately 80 additional acres to the southeast of the Boston Municipal Airport. The enlarged area will give an all-way field of 2,500 ft. or more in all directions. Boston also awarded contracts for construction of a temporary timber seaplane ramp on the southerly side of the municipal port.

Bids were opened Jan. 12 for preliminary work on the Hog Island site of Philadelphia's proposed air-rail-marine terminal. The contract was to be awarded for removing 34 complete slipways of the old shipyard, part of fifteen others and 33,000 pilings which are on the site of the proposed seaplane base. All former government buildings are to be demolished, also, and the ground rolled so that the area may be available for emergency landings until money is available for completion of the $5,000,000 project. This is not expected to me supplied until autumn.

Plans for the development of the New Orleans $1,500,000 lake-front municipal airport have been approved by the Levee Board. Bids for construction of a seawall are to be opened Feb. 6 and filling is to start soon thereafter.

The growing volume of airport traffic is indicated by Newark's recent report that during 1930, 1,000,000 lb. of air mail passed in and out of that terminal and that airlines operating from the field carried 34,058 passengers. With 62 scheduled arrivals and departures each day, Newark claims more regular traffic than any other port in the world.

AERIAL LAW

A CONFERENCE of great importance met at Washington on Dec. 16 and 17 to discuss state law affecting aviation. Papers were presented by Messrs. F. B. Rentschler, president of the Chamber of Commerce, and others, all dwelling upon the desirability of securing uniformity of legislative pro-

visions. Discussion turned largely upon the practicability of simply adopting federal laws by reference in state law. Chester W. Cuthell, of Curtiss-Wright Corporation and the New York bar, was much opposed to adoption by reference or to requiring a federal license in all cases, believing that such a provision would be held unconstitutional in many states. He recommended rather provisions to require either a federal or a state license alternatively. Other lawyers, and especially M. H. Davis of Kansas City, disagreed with his view. There appeared to be general agreement that some sort of state law was necessary to provide some control over intrastate flying not touched by the federal enactment, and there was evidence of a widespread sentiment that dual licensing, or any super position of state requirements on federal ones for pilots and aircraft already holding federal licenses, was most objectionable. The policy of Pennsylvania was especially criticised in that connection.

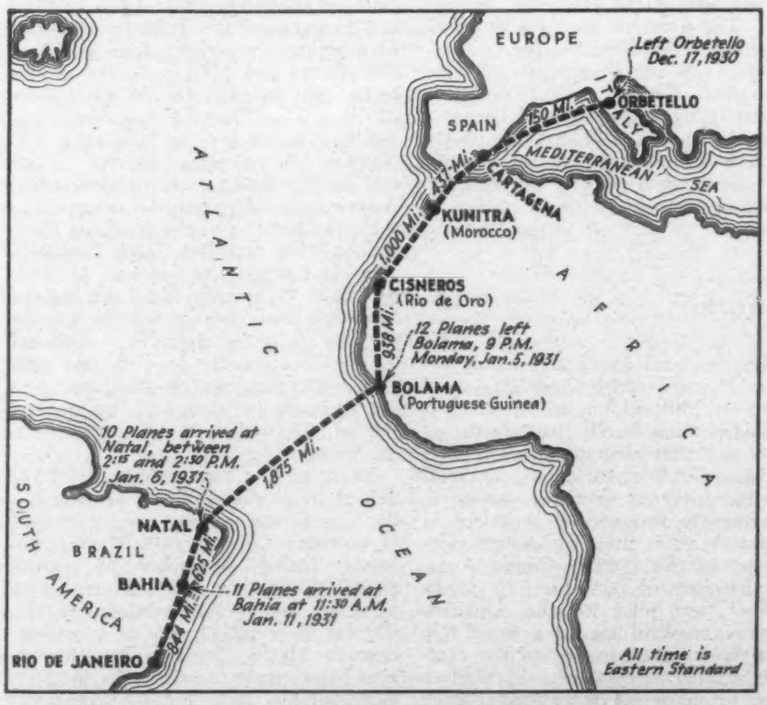
The conference was for the purpose of discussion only, and it was agreed in advance that there should be no action taken and no resclutions passed.

State law has been a particularly live question in California in the past month. Governor Rolph, newly inducted into office, has announced his intention of seeking legislation for a tax on aviation gasoline, the money to be used for developing state landing fields. The joint legislative committee on aviation and the aeronautical committee of the state Chamber of Commerce have both concluded that present aeronautical legislation in California is adequate and that there should be no more law on the subject just now. The legislative committee, however, concluded that not enough machinery for enforcing existing law had been set up.

There have been no important decisions affecting the legal status of airports during the month, but two verdicts have been handed down on the question of responsibility for death in a crash and on the status of the air passenger. The Appellate Division of the Supreme Court of New York held early in January that a clause in an insurance policy exempting the company from liability if the policy-holder met death "as a result of engaging as a passenger or otherwise in aeronautic expeditions" did not apply to a flight on an airline, which was not an "aeronautic expedition." This is analogous with certain decisions in the past which have held that making a short casual flight does not constitute "participating in aeronautics" in cases where such participation is excluded by the terms of the policy.

The Appellate Division in New York also acted in reversing a decision in favor of the Curtiss Flying Service in a damage action resulting from the death of a passenger during a $5 hop. The question involved was one of the negligence of the company's employee. The trial jury had held the accident an "act of God" and the company not responsible. The higher court reversed the verdict, but apparently principally on the ground of the inadmissibility of certain inexpert evidence which had been offered on technical matters.

Another legal matter which is of considerable interest to the industry is the suit Professor Junkers is waging in Czechoslovakia against Henry Ford for alleged violation of a number of Junkers patent rights. The suit was started some time ago, and the first claim, which concerned the corrugated fuselage covering which is characteristic of both the Junkers and the Ford planes, was decided in favor of Professor Junkers. Recently comes a report from Germany that Professor Junkers has won a second point, relating to the construction of a monoplane in which the cargo is carried in the wing instead of in the fuselage.



Route of Italian squadron from Orbetello, Italy to Rio de Janeiro, Brazil.

SHOW AT DETROIT

TURNING for the moment to aircraft shows of 1931, Ray Cooper, manager of the National Aircraft Show to be held in Detroit in April, announces that all available space in the municipal hangar where the show is to be held has already been contracted for. The hangar has a floor area of 200,000 sq.ft., and 117,000 sq.ft. will be used for exhibition purposes. The general admission fee is to be 75c. School children will still be allowed the special rate of 25c.

An innovation in shows is being sponsored by the Pacific Coast Transportation Exposition Association, and will be staged in a large Los Angeles auditorium during March, 1931. The exhibition is to be a joint one including automobile, aircraft, and boat displays.

In spite of the general depression in manufacturing, some organizations report steady progress. At the Stinson Aircraft Corporation's plant, most of the departments are working full time, and several are on a seven-day-week schedule. Contracts for more than $450,000 in ten-place tri-engined Airliners powered with Lycoming engines have been received for delivery by March 10, including ten of the planes for Century Air Lines, the new high-frequency service of the mid-west.

Another indication of where business is to be had is found in the recent purchase, by the Standard Oil Company of New Jersey, of a Fairchild 71 monoplane. This is the twelfth plane that the company has bought during the past two years, and the fleet now comprises two Lockheeds, three Sikorsky amphibions, two Hamiltons, a Curtiss Robin, a Stearman, a Loening, a Fairchild, and a Fleet.

FINANCIAL RESULTS

AN ENCOURAGING 1930 financial report is that of the Douglas company, which records that 1930 was the most successful year in the company's history and that it ended with more unfilled orders than any previous year. The net profits for the period were $782,979.91, equivalent to $2.30 a share on 341,086 shares outstanding, an increase of 96c. a share over the 1929 earnings, and a gain of more than 70

per cent. Sales for 1930 totaled $4,088,779.05 as against $2,546,025.33 for 1929, an increase of approximately 60 per cent.

On the other side of the ledger, we find that the Kinner Airplane and Motor Corporation reported a deficit of $101,315 for the first nine months of 1930, as compared with a deficit of $2,244 for the same period in 1929. Kinner production for the first nine months of 1930 totalled 351 units.

The De Havilland Company reports a net income, for the year ending Sept. 30 last, of $16,420 as against $78,364 for the previous year.

With the idea of consolidating its activities in five centers throughout the country, the Curtiss-Wright Corporation is closing its Garden City, Long Island, plant, and shifting operations to the Buffalo factory. The actual moving will begin on March 1. When the consolidation plan is completed, the manufacture of military planes, and experimental laboratories, will be in Buffalo. Engine manufacture, and engine development laboratories, will be at Paterson. Commercial planes will be manufactured at the Curtiss Robertson plant in St. Louis. Travel Air monoplanes and biplanes will be manufactured at Wichita, Kan., and flying boats and amphibians at the Keystone Works, Bristol, Pa. Incidentally, the moving of the Garden City plant equipment to Buffalo makes this the third aircraft company to leave Long Island in the last two years. The other two were the Chance Vought Corporation, which moved from Long Island City to Hartford, and the Sikorsky Manufacturing Company, migrated from College Point to Bridgeport, Conn.

The Mono Aircraft Corporation of Moline, Ill., has been placed in the hands of Robert A. Cole as receiver. His instructions from the court directed him to continue to operate the company as a going concern. The receivership includes not only the Mono Aircraft Corporation, but the Lambert Aircraft Engine Company as well. The appointment of the receiver was the result of friendly action by two creditors within the industry, and will permit reorganization without interference by additional creditors. The Whittelsey Manufacturing Company, Inc., of Bridgeport, Conn., has also had temporary receivers appointed.

Although domestic aircraft sales for 1930 were far below the 1929 figure, export figures for 1930 did not suffer much. During the first ten months of 1930, exports fell only slightly below the record level of 1929, and registered a total twice as large as that of the same period in 1928. According to the Aeronautics Trade Division of the Department of Commerce, exports of complete aircraft, aircraft engines and parts, not including tires, during the 1930 period were valued at $7,288,014 as compared with $7,761,977 in the 1929 period and $3,664,723 in the 1928 period.

A spectacular foreign sale of American-made aircraft to open 1931 was the disposition of a very elaborately fitted Ford tri-engined club plane to the Earl of Lovelace, a prominent British sportsman. This plane, referred to in last month's news section of AVIATION, was to have been exhibited at the recent International Aeronautical salon in Paris, but inability to get the plane in the building prevented its display.

PERSONNEL ITEMS

THERE have been important personnel changes in the industry during the last few weeks. Announcement has been made of the resignation of Frank H. Russell as vice-president of the Curtiss-Wright Corporation. Mr. Russell, one of the most widely known aeronautical executives in the country, had been with the Curtiss Company for 21 years. He entered aviation in 1909 as the first manager for the Wright Company in Dayton, Ohio. It was Mr. Russell who organized the Manufacturers' Aircraft Association to prevent patent litigation and to permit the application of new ideas without legal confusion. Mr. Russell's plans for the future have not been announced.

The American Aeronautical Corporation, builders of flying boats and amphibions, have acquired the services of G. S. Ireland as sales manager. Mr. Ireland has been active in aeronautics for fifteen years, and was the original producer of the Ireland Amphibion.

It has been announced that Archibald Black, president of Black & Bigelow, Inc., air transport engineers in New York City, has resigned his post, but will continue to serve in the capacity of consulting engineer. A. A. Bigelow, formerly vice-president of the company, has been elected to take Mr. Black's place. The name of the firm has been changed to A. A. Bigelow, Inc.

Fred A. Worthey, manager of the aeronautical division of the Axelson Manufacturing Company and very active in promoting the interests of the aeronautical industry on the Pacific Coast, died at his home in Los Angeles on Jan. 6.

THE AUTOGIRO

THE Autogiro Specialties Company, a Pitcairn subsidiary, has been formed in Philadelphia to function as an engineering and manufacturing service to supply aircraft manufacturers with specialized construction data and parts for autogiro aircraft. James G. Ray, recently resigned as president of Pitcairn Aircraft, Inc., to become vice-president of the Pitcairn-Cierva Autogiro Company of America. C. James Faulkner, test pilot for the Autogiro Company, recently left for a round trip to the West Coast in one of the company's craft to establish distribution centers for autogiros on a national scale. This will be the first showing of the rotor type of aircraft west of the Mississippi Valley.

AIR RACING

SENATOR Hiram Bingham, president of the N.A.A., has announced the conclusion of an agreement, whereby Cleveland becomes the semi-permanent home of the National Air Races, awarded the Races for the next ten years provided that the city is able to satisfy the contest committee of the N.A.A. of its ability to fulfil the conditions upon which the annual sanction is based. Never before have the National Races gone twice to the same city. Cliff Henderson will continue to act as manager.

An invitation seaplane cruise for private owners is projected for the latter part of June by Aviation Country Clubs, Inc., of which Mr. Charles L. Lawrance is the National Chairman. The cruise will be non-competitive, and will extend over three or four days, with intermediate stops at yacht clubs.

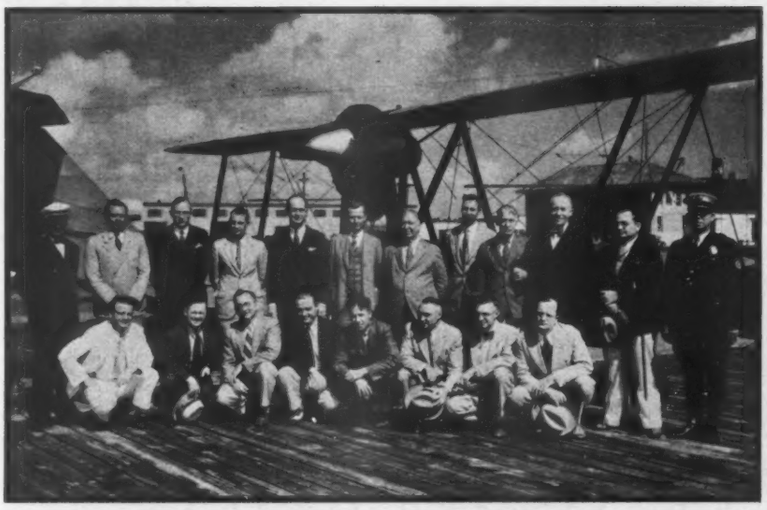
MILITARY AND NAVAL

AIRPLANES are scheduled to play an important part in the fleet concentration and maneuvers to test the defense of the Panama Canal, to be held in February and March. Admiral J. V. Chase, Commander-in-Chief of the United States Fleet, will have charge of the maneuvers and will have under his command, along with 137 ships, 273 planes.

Even more extensive maneuvers are scheduled by the Army Air Corps to mobilize at Wright Field, Ohio, in May, and proceed to the Atlantic seaboard. Five hundred and eighty-four airplanes, 600 officers and 2,500 enlisted men will be brought together for the maneuvers, which will continue for two weeks.

The contract for the building of the Navy's new airplane carrier, which will be the first vessel constructed in America to be originally designed as such, has been let to the Newport News Shipbuilding and Dry Dock Company. The bid for the contract was $15,560,000, and 40 months from the date of awarding the contract will be allowed for the ship's completion. Although the new carrier is to cost less than either the Saratoga or the Lexington, and to be of less than half the tonnage, she will have the same airplane-carrying capacity.

Realizing the local advantages to be gained by having military air bases in the San Francisco Bay region, citizens of northern California voted two bond issues during November to provide $6,000,000 for the establishment of an army air base at Alameda, and $2,000,000 for the establishment of a bombing base in Marin County. An effort is also being made to secure the proposed navy airship base for the Sunnyvale site, also in the Bay District. A bill



The committee chairmen and executives of the Miami air races. Left to right, back row: Robert Moor, war pilots; Lew Sevier, contest; Leland Hyzer, educational; Dr. Cleghorn, first aid; C. H. Reeder, mayor; J. N. Lummus, city commissioner; Frank Wharton, city manager; A. H. Heermance, Miami aviation director; Judge Hancock, hotels; Walter Bruns, advertising; Charles Nieder, trophies. Front row: Dr. Bertram, assistant referee; A. D. H. Fossey, special transportation; R. V. Waters, general chairman; Jack Rice, announcer; Bob Davidson, passes; A. L. Reynolds, transportation; A. W. Eisenmayer, badges; Francis Miller, N.A.A.

calling for its location there is now before the House of Representatives, and a favorable report has been made by the Committee on Naval Affairs, which has given Sunnyvale the preference over Camp Kearny, near San Diego.

AIRSHIP ACTIVITY

THE focal point of lighter-than-air interest these days is the Goodyear Zeppelin Corporation's hangar at Akron, where the Navy's ZRS-4 is reaching its last stages of construction. Now 685 feet of the total length of 785 ft., including the 76-ft. cone-shaped nose, have been set up. Ten of the twelve main frames are in place and the control car, as this was being written, was ready to be raised into position. Three more gas cells are being fabricated in the Goodyear balloon plant. Covering of the frames was scheduled to start some time in January, application being made from the nose rearward. Electricians are wiring the ship for power and lighting plants and work on the huge fins is well under way.

As the day of inflation of this new airship approaches, the Navy Department is giving serious consideration to the possibility of using a mixture of 90 per cent helium with 10 per cent hydrogen for inflations to increase the lift. It is not believed that this percentage of hydrogen will affect the safety of the airship, though with an increase in the proportion of helium the mixture would become inflammable and with 15 per cent hydrogen it would become explosive. The gross lift of the ZRS-4 is to be 402,000 lb. when inflated with helium, 442,000 lb. if inflated with hydrogen and 406,600 lb. if inflated with the 90-10 helium-hydrogen mixture.

After several experiments with methods for communication between ground party and airship crew during landing and takeoff, a new loud-speaker equipment has been installed on the mobile mooring mast at Lakehurst. Six loud speakers are provided with three portable high-frequency transmitters—one in the airship, one for the mooring officer, and another for the assistant mooring officers. Each weighs 12 lb., and will be carried about by the persons using them.

No official report on the findings of the inquiries on the R.101 has been made public. The hearings closed Dec. 5 at London with the explanations advanced by Dr. Hugo Eckener and others holding the limelight. These theories were that gas escaping rapidly from one or more nose gas cells had caused the nose to become heavy and at the same time the stern to become much lighter due to the presence there of the gas which had worked aft from the nose as the ship dipped. This action in turn had increased the ship's dip to an extreme angle from which recovery was impossible.

In spite of the R-101 disaster, which occurred just as the Imperial Conference was opening in London, the Civil Aviation Committee of the Conference produced a report, just released, favorable to further rigid airship investigations. Unremitting search for sources of helium supply in Canada was particularly recommended.

It has been anounced in Amsterdam that Dr. Eckener was to leave for the Dutch East Indies in January by way of the United States for a study of regular airship service between the Netherlands and its colonies. Proposals for such a service have been under consideration for some time.

THE SCHNEIDER TROPHY

REPORTS from Europe indicate that the Schneider Trophy Contest to be flown in British waters some time in September will be a three-nation affair. England of course has entered three machines, the maximum allowed by the rules, and so have both Italy and France. British plans for defense have suffered a terrific blow in the announcement of the Air Ministry's decision to take no part. Royal Air Force pilots will not participate, says the MacDonald government, and the seaplanes that flew to victory in 1929 will not be available. The whole responsibility is thrown on to the Royal Aero Club, which may or may not attempt to raise a fund and mobilize a team. It has been reported that the French team will use three machines of new design, one of which is a Nieuport-Delage monoplane powered with a 2,000 hp. Hispano-Suiza engine. The French team tentatively selected includes Captain Amanrich, Lieutenant Demougeot, and Lieutenant Bougault. There is no report available as yet as to the types of machines to be used by the Italians. However, it is quite probable that a Fiat-powered Fiat will be one of them.

The British Air Ministry has recently placed an order for a long-range plane with which it is proposed to make another official attack on the world's long-distance record. Construction of the plane, which is a Fairey monoplane, fitted with a special Napier engine, has already been begun and the plane is to be completed some time in the Spring of this year. The plane is reported to be designed for a flying range of approximately 7,500 mi. Great secrecy is being maintained regarding the engine.

Persistence is a watchword of the German airmen. The DO-X is to make a renewed start for America within a few weeks. The plane is still at Lisbon, undergoing repairs on the wing which was damaged by fire some time ago.

At a recent meeting of the International Conference for Aerial Safety held in Paris, France, a resolution was adopted to the effect that floating meterological stations are essential to trans-Atlantic air travel, and that if government financial support is not made available such stations should be established by private capital. The resolution was one of more than a score adopted at the final session of the Congress, and cited innumerable cases where an advance knowledge of weather conditions has been of great help to pilots.

The French Air Ministry reports that planes of 116 new types were purchased or ordered in 1930. The 1930 purchases came to a total figure of about $5,500.-000. an average of just under $50,000 a plane.

THE 1930 PARIS SHOW... EUROPEAN AND AMERICAN PRACTISES

By R. J. de Marolles
French Correspondent of AVIATION

STATISTICS OF 1930 PARIS SALON

	No.	Per Cent
Total planes entered	67	....
French planes	52	77.5
Foreign	15	22.5
Civil planes	46	68.7
Military and Naval planes	21	31.3
Land planes	54	80.6
Seaplanes	9	13.4
Amphibions	4	6.0
All wood construction	9	13.4
Wood and fabric	11	16.4
Metal and fabric	17	25.4
All metal throughout	13	19.4
Composite (wood and metal)	17	25.4
Monoplanes	54	80.6
Biplanes	10	14.9
Sesquiplanes	3	4.5
High-wing monoplanes	44	65.6
Center-wing monoplanes	1	1.5
Low-wing monoplanes	9	13.5
Pure cantilever (all types)	22	32.8
Rigid bracing (all types)	31	46.2
Flexible bracing (all types)	14	21.0
One place	7	10.5
Two place	31	46.2
Three place	6	8.9
Four place	4	6.0
Five place	4	6.0
Six to ten place	7	10.5
Eleven to twenty place	6	8.9
Twenty or more	2	3.0
Open planes	32	47.8
Closed planes	35	52.2
Single engined	51	76.0
Twin engined	4	6.0
Three engined	8	12.0
Four engined	4	6.0
Radial engined planes	36	53.7
Vertical-in-line	6	8.9
Inverted-in-line	2	3.0
Total air-cooled	44	65.6
Water-cooled	23	34.4
0-50 hp.	1	1.5
51-100 hp.	14	20.9
101-150 hp.	7	10.5
151-200 hp.	0	0.0
201-300 hp.	10	14.9
301-500 hp.	12	17.8
501-1,000 hp.	14	20.9
1,001-2,000 hp.	7	10.5
More than 2,000 hp.	2	3.0
Tractor propeller	56	83.5
Pusher propeller	5	7.5
Tandem propellers	6	9.0
Touring and training types	24	35.9
Transport	18	26.8
Special (speed, etc.)	4	6.0
Observation	6	8.9
Bombing	2	3.0
Pursuit	6	8.9
Ambulance, practice, etc. (military)	7	10.5

Only machines shown in manufacturers' own booths are included in the above survey. There were in addition some twenty or more planes at the show exhibited by the French Air Force and by various accessories makers. All these machines were of well-known types and cannot be considered when trend of design is in question.

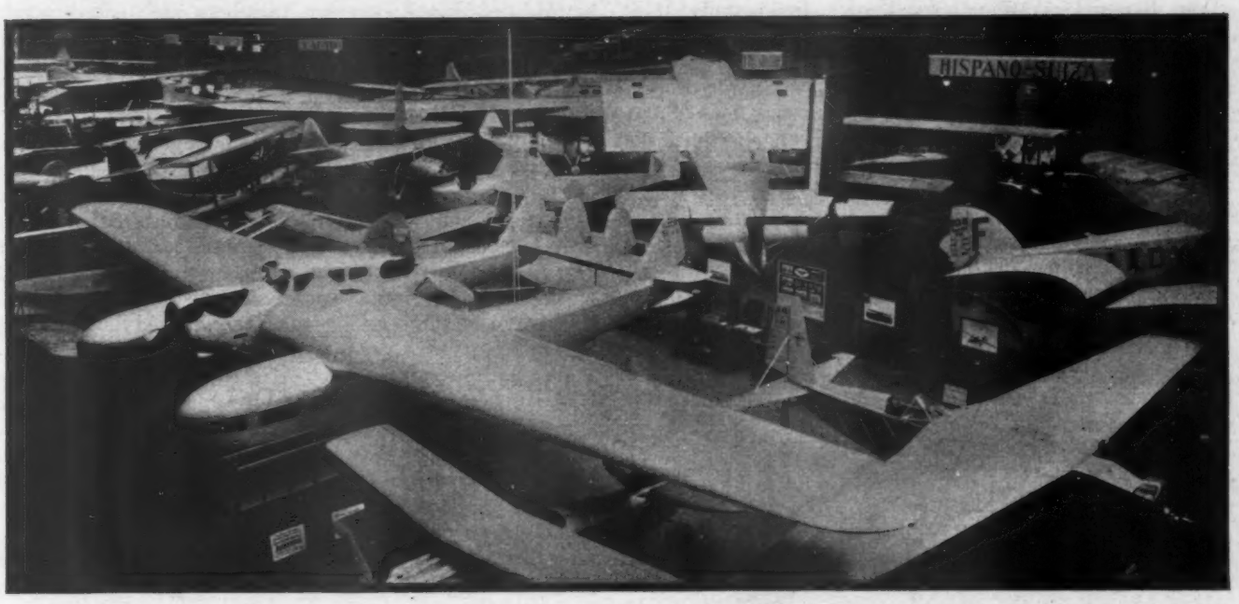
HELD once more in the Grand Palais des Champs Elysées, the Paris Aero Show, twelfth of the series, attracted, between Nov. 28 and Dec. 14, much bigger crowds than ever before. Notable representation of eight nations gave it unusual interest; the coming of the first International Congress for Air Safety added a note which was favourably commented upon by the general public.

The 1930 Salon was characterized by soundness and practicability of the exhibits rather than by originality at all costs, as has sometimes been the case. There were few "striking" machines, but nearly every one appeared capable of good all-around service, with many really clever designs. It was universally regretted that no American plane was present; the only one entered, the three-engined Ford, failed to appear and remained at Le Bourget airport.

From the aesthetic point of view, the show was perhaps not so fine as some of its predecessors. Clearly, machines are beginning to grow too big and the Grand Palais, huge as it is, becomes rather inadequate for so many large modern transport and bombing planes, some of which could not be exhibited except with their wings removed.

As usual, military machines formed a notable percentage of the total, a fact which should not be lost sight of when making comparisons with American shows. This year, however, they were much less numerous than formerly. Bearing this in mind, the statistical table on the left indicates general tendencies of European construction and provides interesting data when compared with that published in AVIATION for April 19, 1930 (page 797) summarizing the year's American shows.

The outstanding fact is the remarkable revival of the monoplane, more than four-fifths of the planes on view being of that class. The rigidly braced high-wing type is the most popular, although both low-wing and cantilever show signs of increased interest. Aspect ratio is generally in the neighborhood of 7, although this figure is exceeded in many cases; wing loadings above



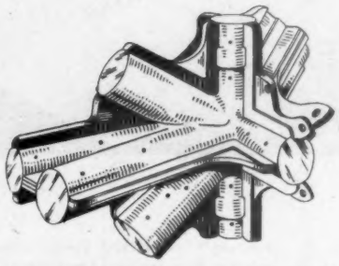
General view of the Paris Salon. The twin fuselage commercial Bleriot is shown in the foreground—left and the Guillemin J.G.40 ambulance plane, right. Behind the Bleriot is the hull of the Liore et Olivier Le H.27, powered with four 600 hp. engines for South Atlantic service.

13.5 lb. per sq.ft. are not infrequent, while big flying-boats are often above 16 and sometimes above 20 lb. per sq.ft. Ailerons are almost universally long and narrow, many being of the "inset" type. Few balanced controls are to be found, either for ailerons or tail surfaces. There are many rigid control systems, frequently with ball-bearings everywhere; in some cases, the rudder alone is actuated through flexible cables. The use of the orthodox rudder-bar is predominant and, although they are increasing in number, pedals appear much less favoured in Europe than in America; wheel control is to be found only on very big planes, the usual stick having more supporters.

Those who are particularly interested in following the details of European aircraft design can do so through the European journals, but no European paper can give a proper comparison of European and American practice. In addition to giving a general summary of the content of the Paris Salon, M. de Marolles has devoted himself particularly to a comparison of the trends there revealed with those that the American industry has been manifesting. In spite of all the international exchange of information of the last dozen years, there remain striking national differences in design tendencies, and especially in the materials and types of structure that are approved in the various countries. In this article, the Grand Salon has been seen with the eyes of the American engineer.

A second point is the attention given to safety. Multi-engined planes are steadily developing; the twin-engined machine has few devotees, whilst the three-engined type gains favour. The question of night flying, both for passengers and mail, is given serious attention and it is agreed that three engines constitutes an absolute minimum. So, many such planes are exhibited, ranging from the little Couzinet 30 with 40-hp. engines (the ship was designed for three 85-hp. engines, it must be said, but it flies astonishingly well with its present tiny power units) to the big Fokker F.IX with 500-hp. engines. There were also a few four-engined craft. Much more attention than heretofore is now paid to engine installation, with a view to reduce both chances of failure in flight and fire hazards. Gas tanks are placed as far as possible from power units, some of them are fitted with fireproof coverings, many are instantly dropable in flight. Fire walls with some form of sealed joint for engine control rods are universal; the fitting of fixed fire-extinguishing systems and automatic warning devices is mandatory in France. In another direction, modern undercarriages are all of the divided type, very few planes retaining the old type with continuous axle. Here Europe has learned a good lesson from America. Two models of landing gear, retractable in flight, were shown; the first, fitted to the Bleriot 111. pivoted parallel to longitudinal axis, wheels housing horizontally in recesses cut in the low wing's under-surface; second, the Couzinet 30, with wheels retracting inside the lateral engine nacelles, the lowest part of the tires protruding slightly with the wheels in normal upright position. The same may be said for wheel brakes

and tail wheels; almost exceptional two years ago, both these dispositions are now common. Incidentally, it is not without interest to recall here that French machines of 1907-1908 vintage were fitted with tail wheels. Similarly, the first plane with landing gear made of two entirely independant units was the Army type "Antoinette" built in 1911 by Levavasseur (it was in addition the first pure cantilever with thick, tapered low wing); and 1914 bombing Voisin biplanes had wheel brakes. The use of airwheels, now so common in America, is not yet the fashion in Europe; only two planes were shown so equipped. Anti-stall devices are developing; automatic slots were fitted to several machines, while Potez exhibited its "safety leading edge," which is in fact a permanent slot. An interesting development is the Constantin aerodynamic vane, which provides a very simple and light system of automatic pilotage with a minimum of moving parts.



A typical S.E.C.M. joint for tubular structures as employed in the construction of the Amiot 140 monoplane. Aluminum alloy stampings are used in the construction of such fittings.

The third important tendency is the progress of metal construction. Europe, and particularly France, is following in this respect just the reverse of American practice, in that welded steel construction has not been much to the fore (and not used at all in France, since it was vigorously banned by the Service Technique, which has only recently authorized welding, and only under severe control). Light alloys were by far the most favoured materials and are still very frequently used, but interest in welding appears to be developing now. The outstanding novelty in construction is the new Breguet method, which is represented by the Br. 270 "all-steel" observation sesquiplane. Here the whole of the stressed structure is made of steel, almost exclusively in the sheet form suitably shaped, with duralumin for less important parts, such as ribs and covering. The construction is completely rigid and assemblies are carried out without welding, standard bolts being employed where dismantling is necessary and riveting elsewhere. Special care has been taken in design to allow for use of automatic riveting machines wherever possible; the number of rivets is reduced to the minimum. The ship's structure comprises as its fundamental member the single spar of the lower wing, upon which rests the central part of the fuselage, a steel girder box. To the latter is secured the tail member, another steel spar almost identical with that of the lower wing. The central box receives the detachable engine mount in front and the top wing's struts thereupon. A "V"-shaped interplane strut connects top and lower planes on each side. The landing gear comprises two independent streamlined wheels, each mounted in a fork fitted to the bottom plane, with oleo-pneumatic shock absorber and brakes. The crew's cockpits are built as an independent streamlined body resting upon the structure, much as in an automobile. The whole has somewhat unusual lines with its slender tail boom projecting from the stern of the body.

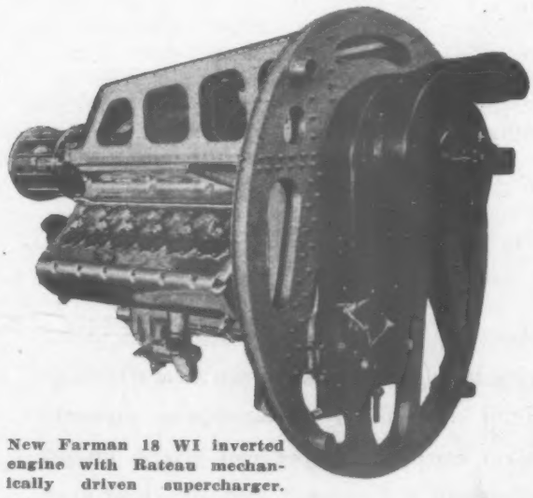
In a combined wood and metal construction, originated by M. de Monge, wooden members are placed inside metal profiles to act both as stiffeners and as a means of assembly. Local buckling occurs only under very high loads, and the covering sheets are fastened by wood screws, making them readily removable.

Another interesting point is the development of the big flying-boat in France, where it has been much neglected of late. The need for a suitable craft capable of regular mail operation over the South Atlantic has been an incentive in this direction, and the Navy is also desirous of possessing better machines for high-sea work. Several French manufacturers have worked on this program and two of them exhibited large flying boats.

In a different direction, it is the first time that enclosed machines have figured so prominently. Here again the American example has been followed.

In regard to types of engines, Europe was until recently rather in favor of orthodox water-cooled models. Supporters of the air-cooled school have now succeeded in obtaining better all-around results, and we find this year two-thirds of the exhibited planes fitted with air-cooled engines.

Apart from airplanes, the other types of flying machines were represented by one Weymann-La Cierva Autogiro, a very orthodox training glider, and parts of the structure of a small Zodiac airship. No other unconventionalities were on display. Certainly design has settled down for a time, and engineers are concerning themselves rather more with matters of efficiency, safety, and lower production and maintenance costs than with experiments with speculative novelties.



New Farman 18 WI inverted engine with Rateau mechanically driven supercharger.

TOURING aviation has now made a start in France, with the strong support of the Air Ministry's premium system. A good choice was on view and the list price of a normal two-seater with a 80-100-hp. engine is generally something around 60,000 and 100,000 francs ($2,400 to $4,000).

A novelty was the introduction of small amphibions for the private owner by Lioré et Olivier and Schreck-F.B.A. Both monoplanes with central hull and pusher power unit above the wing, they had enclosed cabins with good

view forward and downward, but rather awkward vision to the rear.

There are in Europe rather fewer cabin planes with four to six seats than in America, but this class of machine is developing. The Farman 190 was the most noteworthy, having as it does many long fast journeys to its credit, including the recent Paris-Saigon-Paris 14,100-mi. trip in eleven elapsed days by Lallouette and Goulette; the Nieuport-Delage 641 all-wood cantilever monoplane also had interesting features, as did the Blériot 111 braced low-wing monoplane with retractable undercarriage. Bigger transport planes were 8 to 10-seater monoplanes with 500 to 600 hp. water-cooled engines, such as the Dewoitine 30 and Nieuport-Delage 540, both of metal construction and with cantilever high wings.

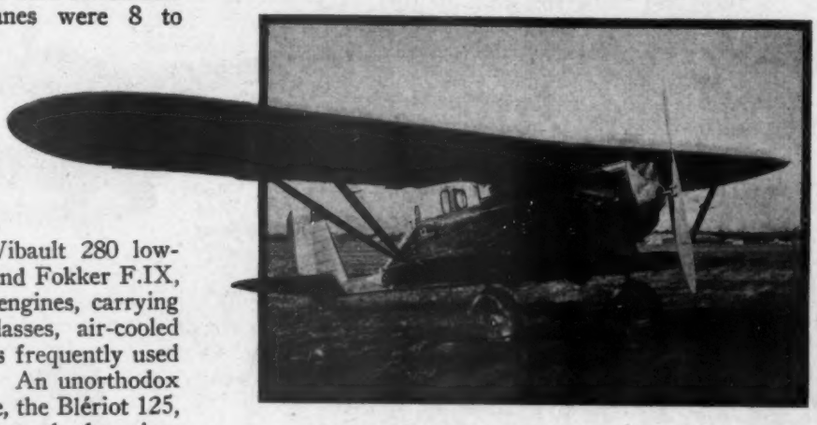
In the still heavier class, tri-engined types of planes were the rule: Farman 300, Latécoère 350, Wibault 280 low-wing, which was all-metal throughout, and Fokker F.IX, the latter, with three Jupiter 480 hp. engines, carrying 22 passengers. In the two latter classes, air-cooled engines of 450 to 550 hp. are much less frequently used in Europe than is the case in America. An unorthodox design was the only twin-engined sample, the Blériot 125, which has twin fuselages suspended beneath the wing, each housing a cabin for six passengers and a tandem wheel undercarriage, while engines in tandem were carried in a nacelle resting upon the wing and containing also the enclosed cockpit.

The flying-boat transport class included the big Lioré et Olivier H. 27 with four 600 hp. engines, designed for South-Atlantic service; only the hull was shown. The machine is a cantilever monoplane built of metal, with a span of 111 ft. The engines, housed in pairs in two nacelles, are accessible in flight through a tunnel in the wing. The total weight is 38,200 lb., including 1,330 lb. of payload and enough fuel for a non-stop flight of 2,000 mi., against a continuous 30-mile head wind. Cruising speed is 124 m.p.h. Another ship for the same purpose, the Latécoère 380, with two 650 hp. tandem engines, was announced, but replaced at the last moment by the Laté. 283 single-engined float seaplane with which Mermoz made the first South-Atlantic mail crossing. One of the star exhibits was the Dornier D.S., a new and improved edition of the well-known Superwal, this time with four 650 hp. Hispano-Suiza engines, placed in two tandem groups above the wing. The new Dornier has 102 ft. span and possesses an unusual bracing, the middle spar being supported by a strut, while the front and rear ones are connected to the hull by pairs of streamlined wires.

Mail planes figured in Couzinet and Société Provençale de Constructions Aéronautiques booths; they were both three-engined monoplanes, the latter made of metal. It must be said here that there are in Europe no mail planes of the class existing in America; fast and powerful single-engined types are unknown. In France nowadays the term mail plane applies rather to a small machine, preferably three-engined, and designed to carry some 450 to 750 lb. at moderate speed with maximum safety by day or night.

Only 21 military machines were on view, including Navy planes. The most interesting exhibit was the new S.E.C.M.-Amiot 140, a multi-seater twin-engined cantilever monoplane with all-metal construction. The 700 hp. Lorraine "Orion" engines are installed on each side, their rear portions being accessible in flight.

Pursuit single-seaters were few, the most interesting being the Dewoitine 27 with which Marcel Doret broke on Dec. 1 the International speed record for 1,000 km. at an average of 178 m.p.h., and the Polish P.Z.L. VI. The latter is an all-metal monoplane with wing-roots thinned and attached to the top longerons of the fuselage, whence they spread out and above for some length, to become horizontal afterwards. A great improvement in vision is claimed for this disposition. [It is, of course, the same as the gull-wing layout used in several recent American designs.—Ed.]



The new Breguet 270 "all steel" observation sesquiplane powered with the 600 hp. Hispano-Suiza engine. Note fuselage shape and unusual propeller mounting.

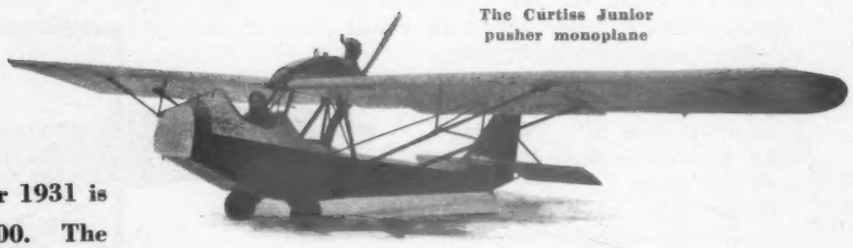
INTEREST naturally centered around the heavy-oil engines which were shown to the general public for the first time. The Clerget, which has already many hours of flight to its credit, was of course the star exhibit. Several samples were placed in various booths and disassembled parts were on view in the Safety Exposition of the Air Ministry, since all the research work was carried out by M. Clerget in the laboratories of the Service Technique with the latter's co-operation. Two types have been made, the 100 hp. and the 200 hp. The second is already an improved model and it is understood that production is to be started soon, the Hispano-Suiza Company having acquired license rights. Other oil engines are exhibited by Peugeot (Junkers licensee) and Coatalen (English).

Supercharging is becoming general practice in orthodox designs, either in moderate form to assist induction, or with higher pressures to maintain power at fairly great heights. Farman has been noteworthy in this respect for years. M. Waseige, the technical director, is now working in conjunction with the Rateau Company, and compressors with several stages and several gear ratios are contemplated.

It must be remarked here that Prestone-cooling does not seem to have been investigated; N.A.C.A. cowlings also were not to be seen, the Townend ring being shown only by Boulton and Paul.

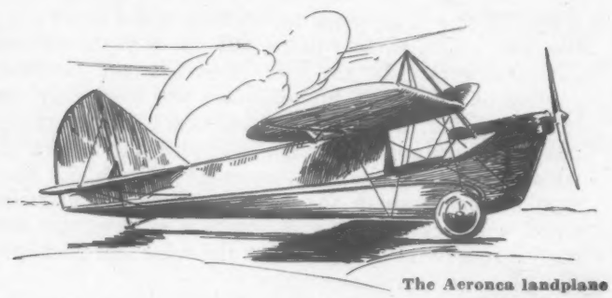
There was the usual number of accessories, impossible to review in this article. It must however be mentioned that inertia engine starters, which were hitherto completely unknown in Europe, are making their appearance.

THE LIGHT PLANE SITUATION



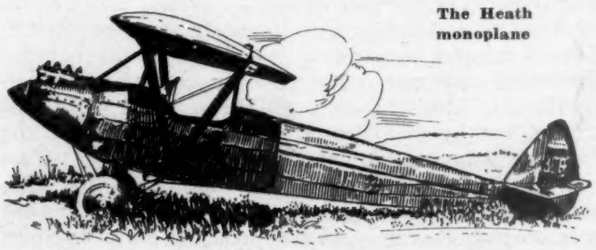
The Curtiss Junior pusher monoplane

The light plane production for 1931 is conservatively estimated at 500. The encouraging prospects, the defects of the situation, and the most discussed types are considered in this article.



The Aeronca landplane

IF there is to be any feature, which will be characteristic of the aeronautical market for 1931, as the glider activity of 1930 was the outstanding innovation for that period, it will undoubtedly be the attempt to promote the sale of light planes, with engines of less than 50 hp. There is much that is legitimate and sound in this general emphasis. There are also many features of the project which would bear a certain amount of well considered



The Heath monoplane

tempering at this time. There is no need for repeating the marketing mistakes of 1929 and 1930.

In 1925, when planes of this class were having quite a vogue in England, there were several factors which hampered any great corresponding activity in this country. Most of the discouragement was furnished by the large number of OX-5 engines available at that time, whose low price and superior horsepower obstructed the development of any cheap and satisfactory small engine in America, and about which were being developed the now orthodox three-place planes, which absorbed the bulk of the capital, energy, and interest then available for aeronautical purposes. The absence of any real number of potential pilot-owners was also a definite deterrent.

The present situation is somewhat more encouraging, especially if 1932 and 1933 are considered, as well as the present season. The mounting of OX-5 engines is becoming outmoded as far as new planes are concerned. There are approximately 6,000 more licensed pilots than licensed airplanes and there are 20,000 current student permits, according to a recent bulletin issued by the Department of Commerce. Several good engine types are being offered in this power range and more are in prospect. Engineering and manufacturing technique has advanced. The 200-hr. requirement for the transport pilot license has created the need for inexpensive instruction and flying experience, and sport flying is on the increase.

Definitely and for all time, there are certain limitations in speed and capacity of these very light planes, which render them less attractive for cross-country and some other purposes. And there is in the making an extreme example of a characteristic of past aeronautical markets, which has prevented the achievement of industrial stability, and been an obstacle to the reaping of any substantial financial profits by any single or small group of manufacturers—too many types, too many sources, active or potential, of a product for a distinctly limited market.

MOST of the preceding general considerations, are as much a part of last year's history, as they are an estimate of the present situation and future prospect. The opening of 1930 found but one factory building planes of this class, which had achieved any appreciable production in the past, the Heath Aircraft Corporation of Chicago. Heath planes have been known to the industry since 1925, when they began their still unbroken series of victories in the 110-cu.in. class at the National Air Races. Available in both the assembled and "complete parts" condition, they continued in moderate production throughout the year. The yearly total for 1930

of the factory assembled product, as closely as it can be untangled from all types of Heath derivation, is 55.

Early in March a new type of plane received its first federal identification numbers; between that date and the end of June, 85 Aeroncas manufactured by the Aeronautical Corporation of America were identified. Its presentation, as ill luck would have it, coincided almost exactly with the first serious cuts made in plane prices in order to reduce extensive inventories. What the reception to these Aeroncas would have been, without the competition of planes of three times the power dumped at approximately equal prices, makes an interesting matter for conjecture.

After the first of July a third light plane began to appear, the American Eaglet, a product of the American Eagle Aircraft Corporation of Kansas City, Kan. July, August and September saw the identification of eight of them, and the last three months of the year approximately 24 more.

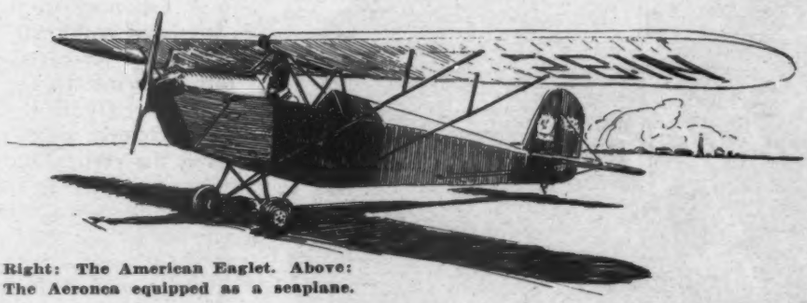
These three were the only ones which exceeded a production of three or four planes in this size class during the entire year. There is, however, one more statistical phenomenon for the period which drives home our last general statement, concerning an over-abundance of types and sources. In the first half of 1930 there were 44, in the third quarter 50, and in the last quarter 49 miscellaneous planes with engines of less than 50 hp. appearing on the weekly lists of government identifications and licenses, which are published by the Aeronautical Chamber of Commerce. These are minimum figures, the lists give names of planes and engine but not the horsepower, the above totals include only the definitely recognizable ones. When the engine is given as an Indian, Henderson, Ford T, Cleone, Szekely, or possibly a half a dozen others, the plane of our class can be spotted, as is also possible from the names of some of the planes themselves, but when the designation is simply that of a Jones plane with a Smith engine, one is completely at a loss whether one is dealing with a craft of 15 hp. or one of 1,000. The term miscellaneous is by no means without intent. Of the total 143 there must be 130 of different models and about the same number from different factories, or should we say sources. Of course the large number of these are orphans without prospect of issue, but there is probably a surprising portion of them which are seriously considered as "the coming air flivver" at their local airports. Nor can they all be dismissed as technically without merit, many of these airplanes have been competently and ingeniously designed. If no light plane market develops, 125 of the 130 types will linger in the memories of their designers and test pilots alone; if such a market does develop, even temporarily, there are perhaps 20 which might be hoisted on to the band wagon.

The tabulated results of the identification and license survey is given below:

Type	1st 6 Months	3rd Quarter	4th Quarter	Total
Heath.....	23	27	5	55
Aeronca.....	85	6	9	100
American Eaglet..	9	8	24	32
Others.....	44	50	49	143
Total.....	152	91	87	330

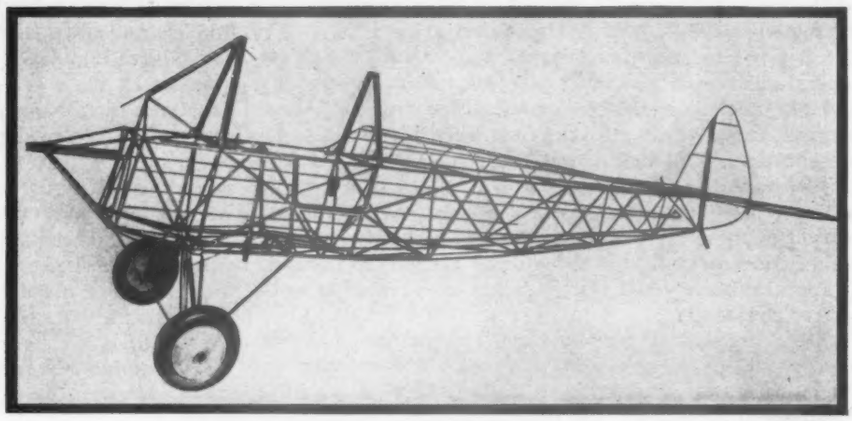
An attempt to describe all the planes in this class or even any large number of the technically important ones is obviously impossible. We have therefore selected four entirely on the basis of apparent public interest: the Aeronca, the Heath, the American Eaglet, and the Curtiss Junior. The general requirements for a successful design in this field are a high performance at low power, a ruggedness to withstand the stresses and strains of flying by beginners, and a simplicity of structure and fittings, which is important in achieving low priced production. The planes selected have attacked their common problem along parallel lines, but with enough individuality to form the basis for an interesting school of design practice.

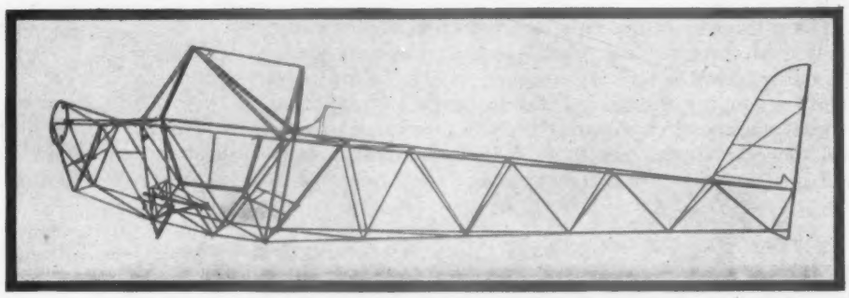
Planes of this size and power have been miscalled power gliders so often that it is possibly worth while to consider just how much of their design shows any motorless influence. The Heath, from its history and general lines, is obviously a simple scaling down of airplane design features. The other three have the high aspect ratio wings, comparatively low landing angles, and fuselage lines generally reminiscent of secondary gliders or soaring planes. But the first feature is one indicated as desirable from any aerodynamic point of departure, the



Right: The American Eaglet. Above: The Aeronca equipped as a seaplane.

second was carried to an extreme only by Aeronca, who we understand is already abandoning it in a coming 1931 model, and the fuselages certainly show little of the refinement associated with advanced soarers. Furthermore, according to the best available information, at least three of the four individual designers concerned had little or no experience in glider design previous to their work on these planes. Let us abandon once and for all our conception of this class of plane as glorified gliders.

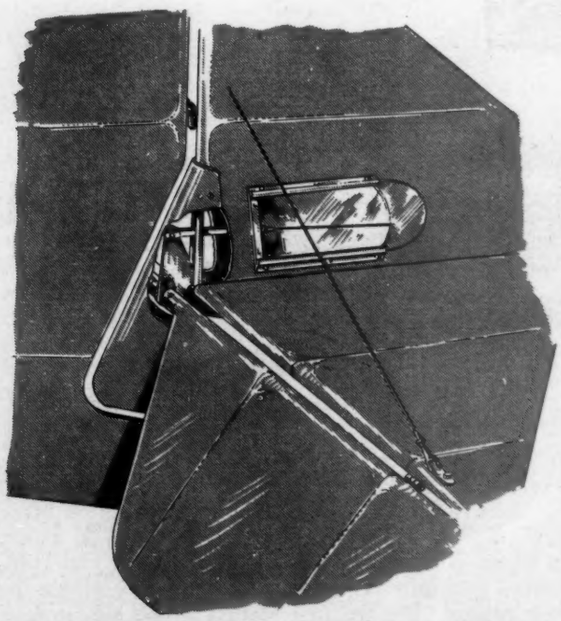




Upper: Heath fuselage. Lower: Fuselage of American Eaglet

THERE are certain points of similarity in all four planes, they all have fuselages of welded steel, they all use wooden spar and rib construction, and they all are fabric covered. As for general differences, the Curtiss Junior is a pusher while the rest are tractors. The Junior is also definitely a two-cockpit, two-passenger machine, the Heath definitely a single-seater, while the other two are single-seaters with arrangements for a passenger.

The present model of the Heath, designed by E. B. Heath, continues the use of welded tube ailerons and tail surfaces, and their distinctive landing gear. The latter is of the split type, with struts only in the plane of the axle, the forward and backward forces being taken by bracing wires in the plane of the outer leg. A door in the side of the fuselage, a window in the wing for increased visibility, and a feature which allows the wing to be dismounted by removing only six bolts, add greatly to the convenience and efficiency of operation. The plane is powered with the Henderson motor-cycle engine which has been greatly modified to suit it to aeronautical purposes. A large number of optional features are offered. A larger wing of 127 sq.ft. area for flying in regions of high altitudes, struts and fittings by which the parasol wing is converted into a low one and is attached to the bottom longeron, duralumin propeller, wheel brakes, ski and float equipment, are all available to the purchaser.



Aeronca tail group showing inside elevator horn

The Aeronca exhibits possibly more originality in detail design than the other three types. J. A. Roche and R. A. Galloway are the designers. Its ailerons are built entirely of duralumin, the skin of which is of flat stock, into which strengthening transverse grooves have been formed at intervals of about 5 in. The resulting surface is wonderfully light. Control horns throughout the plane are extremely simple, the elevator horns being housed inside the vertical fin structure. The fuselage is rectangular to the rear of the cockpit; aft of this point the two top longerons are brought together into a single member. The planes first appeared with ordinary tires mounted on an axle fastened into the lower part of the fuselage through units of shock absorber chord. These were later replaced by air-wheels on a rigid axle. The tread in both cases was extremely narrow and the landing angle low. As we mentioned above a coming model for this year will have a more orthodox type of landing gear as well as definite side-by-side seating capacity for two people. The Aeronca engine, so far produced by the same factory, is used. It is of the two-opposed-cylinder type, its crank cas[illegible]airing into the nose of the fuselage.

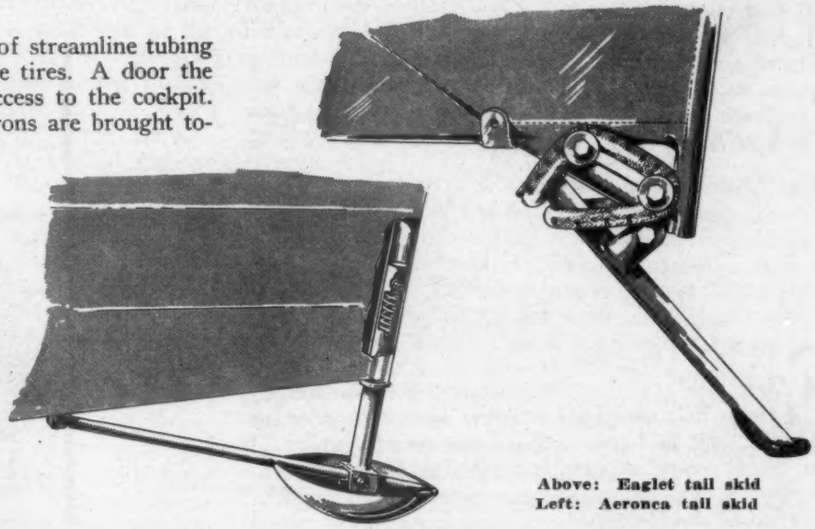
The Amer[illegible] Eaglet, designed by D. H. Webber, has several features which distinguish it from its fellows.

	No. of Seats	Engine	Horsepower	Span	Height	Length	Wing Area	Wing Loading	Power Loading	Gross Weight	Weight, Empty	Top Speed	Fuel Cap.	Service Ceiling	Price at Factory*
Aeronca..	1-2	Aeronca E-127.....	30-at 2500	36-0	7-0	20-0	144	5.35	23.3	700	375	85	5 gal.	16,500	$1,495
American Eaglet	1	Cleone.....	25-at 2600	34-4	6-6	21-6	164.4†	....	24.25	606	366	60	5 gal.	8,500	995
American Eaglet	2	Szekeley.....	35	34-4	6-6	21-6	164.4†	....	.....	...	...	..	....	.....	1,395
Curtiss Junior..	2	Szekeley SR-3.....	40-at 1800	39-0	6-4	20-10	175	5.1	22.5	900	495	80	8 gal.	8,000	1,490
Heath.....	1	Heath-Henderson..	30-at 3000	25-0	4-6	17-0	110	5.28	19.3	580	280	70	....	12,500	975

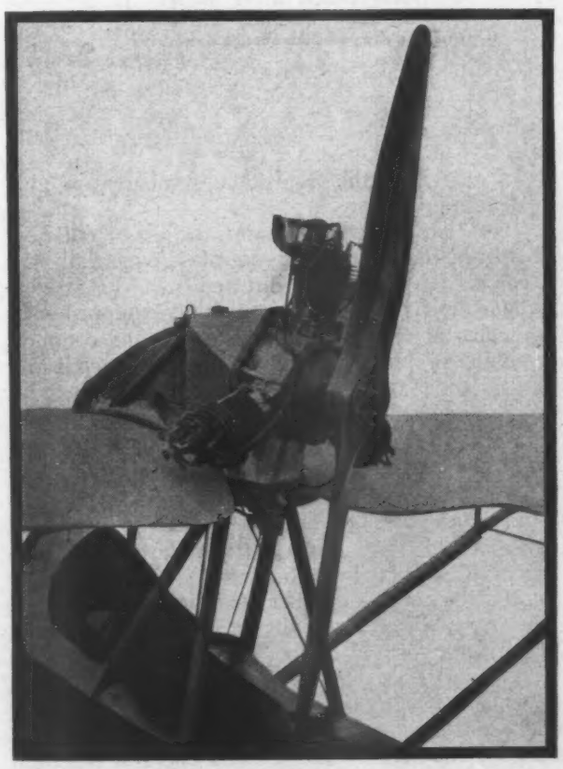
*Prices latest available. †Including controls.

Its landing gear is a rigid structure of streamline tubing equipped with 7x16 in. low pressure tires. A door the depth of the fuselage gives easy access to the cockpit. The tubes forming the lower longerons are brought together at a point half way between the cockpit and tail post. It is powered with either the Cleone or the small Szekely engine. The plane with the latter engine is designed to carry two people.

The Curtiss Junior, which was designed by Karl H. White, marks the first important reappearance of the pusher installation in an American landplane in some years. For this particular size of plane a pusher should prove attractive because of its elimination of oil spray and exhaust gases, and its decreased propeller blast into the cockpits, and also because of its increased effectiveness on the control surfaces in the tail. The landing gear is very interesting, being a rigid yolk, formed of streamlined tubing, fastened to the lower longerons. The only exposed parts are the downward and outward projections about a foot in length, on which are mounted the low pressure tires. The fuel tank is placed in a center section and permits a full gravity feed to the engine, which is the larger model of the Szekely. The fin is built integrally into the rear of the fuselage and forms a rigid support for the entire tail group.



Above: Eaglet tail skid
Left: Aeronca tail skid



Engine installation on Curtiss pusher

The external bracing of the wings in the four types is widely varied. The Aeronca wing is entirely braced by streamline wires running upward from the bottom longeron and downward from a cabane. The Heath wing is braced by two struts which meet at a point in the bottom longeron and a system of drift wires. Both the Eaglet and the Junior are braced entirely by struts and tubing members. An advantage is claimed for this last type in that it is comparatively fool-proof when the assembly and rigging is of the amateur variety. There is possibly some small aerodynamic penalty paid for it however.

The tail skids again show a variety of choice. The Heath and Junior use the leaf spring, while the Aeronca and Eaglet have adopted the designs shown in the accompanying illustrations.

A table has been prepared of the general dimensions and claimed performances for the four planes, which appears at the top of this page. So great are the difficulties of accurate measurement and so wide the resulting variations that landing speeds are not included.

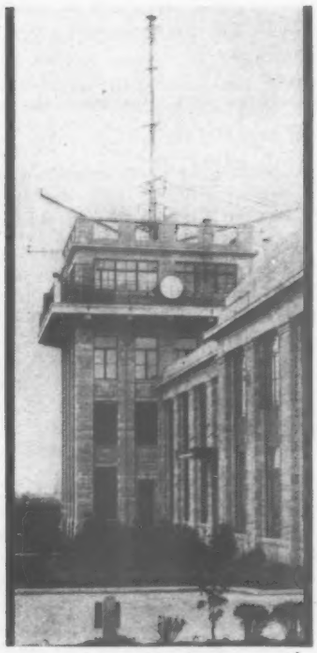
The Aeronca and Heath have been successfully flown as seaplanes and float equipment is provided for in all three types. It is understood that the Aeronca is being groomed for an attempt at some of the records for seaplanes of the lightest class. The results are awaited with interest.

AVIATION RADIO IN EUROPE

A comparison of European and American methods of radio application to aircraft use

By Gerald C. Gross

Engineer, Federal Radio Commission



The radio control tower on the administration building, at the famous Croydon Airport, England

EUROPE appears to have awakened to the need of radio in commercial aviation almost as soon as passenger, mail, and freight flying was established.

In recent years, reports innumerable about the efficiency of radio communications in European aviation have reached the United States. Coming at a time when American flying interests were absorbed in the problems of adapting radio, these reports have been studied with deep interest.

Yet they have been conflicting, if not fragmentary. It was to determine whether European aviation had developed any uses for radio which might be beneficial to commercial aviation in the United States, that the Federal Radio Commission dispatched me on a tour of inspection of Europe's major airways to study their radio systems. This tour was made immediately following the close of the conference of the International Technical Consulting Committee on Radio Communications at The Hague in the autumn of 1929, which I attended as a member of the American delegation.

My tour, necessarily brief because of limited time, was not begun without certain preconceived notions. Starting from The Hague, the tour included successive stops at Amsterdam, Hanover, Berlin, Cologne, Paris and London; unfortunately, time did not permit flights either into Northern Europe or into the countries along the Mediterranean.

Let me say at the outset that my experience with European air transportation was delightful. As a passenger, I may say conservatively that all my flights were comfortable—in some cases luxurious. With one exception, they were executed with the punctuality of crack railroad trains. That exception was the Channel crossing from Paris to London, during which we encountered strong headwinds which brought us into Croydon 45 minutes late after a rather bumpy trip.

Radio communication between aircraft and ground is based on entirely different premises in Europe from those which form the foundation for the rapidly developing American system. In the first place, in the major countries it is predicated upon the idea of government ownership and operation. This presents certain advantages in the way of centralized operation and responsibility, but it also offers the disadvantages inherent in government operation.

In Europe, as in the United States, the use of radio on aircraft is primarily for the purpose of safeguarding life and property. All efforts are directed toward that end. Thus, while passenger planes are generally equipped with two-way communications facilities, these are confined entirely to the problems of flight. Since they consume precious time and as radio frequencies are very scarce, passenger messages are forbidden. There is even a strict limitation upon the amount of time an airplane radio set may be "on the air" in the course of routine flying.

THE moment a passenger craft checks out of an airport it is subject to close control by the traffic officer at that port. Periodic reports by radio from the plane give its position and the ceiling, weather conditions encountered, etc. The traffic officer at the airport is expected to know the approximate position of the planes in his zone at all times.

An airplane leaving Croydon for Le Bourget, for example, sends a short report to Croydon's traffic officer as soon after the take-off as the radio operator has been able to unreel his trailing wire antenna. This first re-

port provides a check on the apparatus and lets the port officer know that everything is going well.

Then the radio operator calls Croydon once more just before the plane leaves the English coast for the Channel crossing. As soon as the French coast is sighted, he reports again to Croydon; finally, his last report is sent out just before the landing at Le Bourget. Croydon has heard from the plane throughout its voyage to its very destination.

Messages, as previously mentioned, are confined strictly to the business of the flight—from the plane, they report position, flying conditions, conditions of the craft, etc. Superfluous transmissions are strictly forbidden. Radiotelephony is used on most of the French and British planes, while Germany uses code.

Throughout the flight, of course, the plane has also been able to receive reports from the ground stations either at Croydon or Le Bourget. These reports give sudden changes in weather in the path of the plane and, as the plane nears its destination, they give landing instructions.

As for the radio apparatus used aboard the plane, there is little to distinguish it from the types of transmitters and receivers rapidly coming into use in this country—light-weight, compact and usually composite affairs. The principal difference, as will be shown later, is in the frequency bands used. The larger German planes have special radio operators to man the equipment, while the Dutch, French and British usually leave the radio to the co-pilot or mechanic. It is worthy of note that all passenger planes must have their radio in shipshape order or else they remain grounded.

ALL radio services for aviation may be divided, roughly, into three classes:

(1) Communication to and from planes.

(2) Direction finding.

(3) Meteorological reports handled by point-to-point communications systems.

Considering the first of these classifications, namely, two-way communication, it should be noted that up to the present time European aviation has used only the intermediate frequencies, in marked contrasts to the current use of high frequencies, or short waves which are used in the United States. Europe employs frequencies from 300 to 500 kc. (1,000 to 600 m.) for its flying services, the American band lies in 1,500 to 7,000 kc. (200 to 43 m.).

Congestion often leads to interference on European aeronautical radio channels, but this has been overcome to some extent by a careful system of organization and control in the use of each channel. On the whole, radio service on the intermediate frequencies is on a thoroughly reliable basis for passenger flights that are run on regular schedule, although my own observation is that the high frequency or short wave bands offer more "elbow room" for interference-free operation.

Similar two-way communication between ground and plane will soon be furnished along the greater part of the airways of the United States. However, as I have indicated, American progress will be in the high frequency field. American aviation explored these frequencies early, starting when the slate was clean, and in using the short waves we will not encounter the inherent disadvantages of the earlier established European systems.

CONSIDERING the second of the foregoing classifications, direction-finding for aircraft, Europe again presents a different picture. While in America the trend has been toward the development and establishment of radio course beacons of the aural and visual type, designed to guide the pilot along fixed routes, the tendency in Europe has been toward the establishment of the direction-finding stations on the ground. These stations are similar to those used by sea-going vessels which in this country obtain position reports from our naval costal stations in the United States.

In other words, we attempt to guide the pilot directly by means of course signals which tell him whether he is on or off a true course, while the Europeans try to guide the pilot by taking bearings on his position from signals emanating from his transmitter and then transmitting back to him the proper instructions.

The direction-finding system has many advantages. A pilot in doubt of position because of darkness or fog needs only to call the control station of the general area over which he is flying. In two or three minutes, by a system of cross-bearings, his position with respect to a given geographic point will have been radioed back. This

A flight photograph of Le Bourget Field, Paris, France

position, calculated carefully, is usually correct within two or three kilometers.

The following are the systems of control stations for direction-finding over the various air routes of Europe:

For England—Croydon is the control station, with stations at Pulham and Lympne for cross bearings.

For France—LeBourget is the control station, with Lympne and Valenciennes operating for cross-bearings.

For the Germany-Belgium route—Brussels is the control station, with Valenciennes and Rotterdam operating for cross-bearings.

For the Holland-Germany route—Rotterdam acts as the control station, with Pulham and Brussels operating for cross-bearings.

All reports between airports are handled on the frequency of 333.3 kc. (900 m.) which is also the direction-finding wave. In England and Holland, the Bellini-Tossi system, so called for its inventors, is used. It consists of two fixed loops whose turns are at right angles, installed on the roof of the control building. Connection wires extend from these loops to a goniometer operated in the receiving station. This goniometer is simply a miniature cross-loop arrangement having two inner cross-loops within larger exterior ones and attached to a revolving shaft in such a way that the small loops can be rotated to obtain the same effect as though the large crossed loops on the outside of the building were themselves revolved.

The Germans and French prefer to use the rotating loop system, in which the loops themselves are rotated directly. Positions may be given as a true bearing in degrees if requested by the pilot, instead of in kilometers from a given point.

The range of most of the transmitting stations on the ground is such that they are able to transmit and receive consistently up to 250 mi. in daylight, operating all direction-finding signals up to a distance of 150 mi. German planes often report hearing Croydon when they are flying over Danzig, more than 1,000 mi. away.

It should be noted that the direction-finding impulses are the waves carrying the voice or code from the plane; there is no need of a special signal. By a system of triangulations with the cross-bearings stations, the precise location of the plane can be plotted. Direction-finding is not uncommon on American airways even today.

THE direction-finding system is international, and the same procedure is used all over Europe. Its details are worked out by the unofficial International Air Conference (Conférence Aéronautique Internationale) which meets twice a year, usually in the spring before the summer flying season begins and in the fall before the winter season sets in.

The governments send unofficial delegates. The conferences are purely advisory, yet so great is the mutual interest in a uniform system that the regulations there drawn up inevitably have a bond of moral if not legal force. The following nations participate: Great Britain, France, Belgium, Holland, Germany, Czechoslovakia, Saar Territory, and Switzerland. There are also informal conferences from time to time between Germany, Holland, Denmark, Norway and Sweden, affecting matters of mutual interest.

With respect to the third of the classifications, i.e., point-to-point services for meteorological reports and inter-airport traffic data, it is interesting to note that practically all transmission is on the low frequencies, or long waves, from 150 to 239 kc. (2,000 to 1,260 m.). Meteorological reports are handled, (as in this country by the Department of Commerce airways broadcasting stations), as periodical broadcasts. Each city in a network is assigned a definitely scheduled hour of transmission, during which time it sends its synoptic messages. It must remain silent during the broadcasts from others in the net.

These messages are sent out "broadcast," which means that they are picked up all over Europe simultaneously by the various receiving points and that no acknowledgement of reception need be sent back. The synoptic messages themselves are in the regular meteorological code, so that they can be handled expeditiously and with as little time as possible wasted in superfluous emissions.

WHILE the use of high frequencies, or short waves, is developing fast in Europe's commercial radiotelegraphic systems, very little progress in their use in aviation can be reported. Most of the meteorological point-to-point stations, when I was there, had installed, or were installing, high frequency transmitters of an experimental character. These were intended to be operated simultaneously with the regular low frequency sets, but they were not expected to supplant the low frequency apparatus for some time to come.

In fact, considerable surprise was expressed by various aviation operators when I mentioned the fact that commercial aviation radio in the United States was being developed primarily with the high frequencies, and that the Federal Radio Commission had even assigned as high a frequency as 3,106 kc. (96.5 m.) as the national calling and working frequency for aircraft.

Besides the regular direction-finding services from the ground, I observed some progress, notably in Germany, in the use of direction-finding apparatus on board the planes themselves. These, however, were working in the intermediate frequency bands. The Deutcheversuchsanstalt für Luftfahrt (German Aeronautic Testing Institution) has been conducting tests for short wave direction-finding which may later justify high frequency equipment as standard.

The handling of radio traffic between ground and plane has been developed to a highly efficient state in Europe. American operating companies which are only now building up their radio systems might study this phase of European aviation radio to advantage. Even though intermediate frequencies are employed, resulting in some crowding and in a flat prohibition upon messages of minor importance, the radio traffic is speedily and expeditiously handled.

Government control and operation, as I have stated, presents the advantage that operations are centralized and can thus be handled under efficient, unified control.

On the other hand, as in all government operation, the tendency toward individual initiative and progress seems to have been somewhat removed in Europe. It certainly requires a longer time to make technical advances in the art, and there is a certain slowness about superseding or displacing older methods and equipment with new developments that are more efficient.

It is apparent that American commercial aviation is ahead of the rest of the world in the use of high frequencies for aircraft communication. If the plan worked out by the Federal Radio Commission and the other government departments in cooperation with the commercial operators fulfills expectations, the American system will, undoubtedly, be used by the rest of the world as a guide and model upon which to base similar developments.

ORGANIZING AIRLINE MAINTENANCE

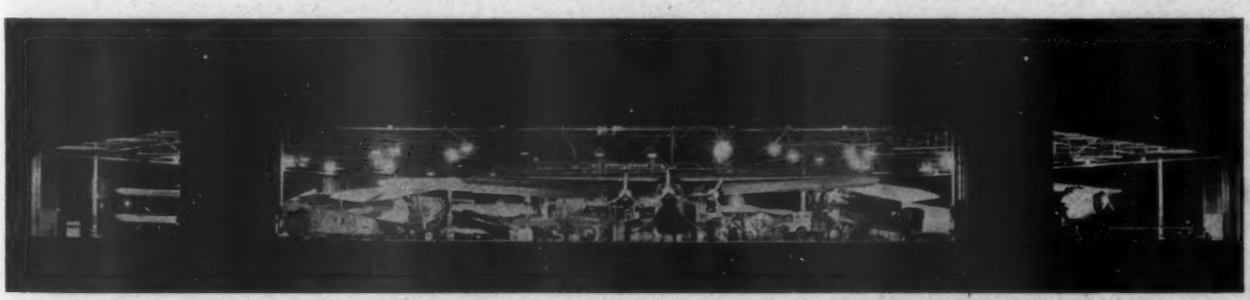
There is no more vital part of an air transport enterprise than its maintenance system and the quality of this work often spells success or failure for the entire venture. Reliability is more important in the air than in any other form of transportation and can be achieved only by the most rigid maintenance methods. The accompanying article is the result of a study of the systems of several western operators.

TO GAIN public acceptance of air transport equipment must be kept in a condition which is no perceptible degree short of perfection. If the equipment of a transport system, air or otherwise, is properly maintained it is possible to operate to schedule, to gain public confidence and build up patronage, to hold costs to a minimum, and to earn a profit. The problem is squarely up to the individual in charge of operations, and his service department. An examination into some of the servicing methods employed by a group of typical air transport operators of the Western states is most instructive.

It is the contention of many aircraft operators that by thoughtful replacement of worn parts, no plane or engine need be worn out in service, the chief retiring factor at the present time being obsolescence. For instance, planes operated by Transcontinental and Western Air, Inc., have flown from 1,703 to 1,905 hr. prior to major overhaul and have then been completely re-conditioned and modernized and placed back in service practically on a par with equipment just out of the factory. Several Boeing 40-B mail planes have been flown more than 3,000 hr. and are still flying. Douglas mail planes operated by Western Air Express have reached a total of 2,600 hr. of flying time and tri-engined Fokkers have been flown a total of as much as 2,365 hr. and are still in active service. Liberty engines operated by this company have been flown up to 2,100 hr. and Pratt & Whitney Wasps to more than 2,300 hr. and are still in service. There is, however, still much experience to be gained in this phase of maintenance and it is probable that certain parts and units will have to be discarded after a certain period of life as a protection against fatigue within the structure of the unit.

Careful routine servicing has eliminated the engine "top overhaul" in the Transcontinental and Western Air shops and makes it possible to run engines through between major overhauls with very little work and attention other than routine servicing. Periods between major overhaul of engines have reached as high as 500 hr. or more on some lines. Another significant factor in engine maintenance is that the engines are more reliable after their first 200 hr. of service if adequate maintenance methods are used. The reason is that cumulative knowledge of the performance and idiosyncracies of each engine which is gained by the service shop as a result of actual operation makes it possible to anticipate trouble.

IT IS necessary next to devise a program of work to be done which will guarantee that no part of the plane or engine will fail to receive necessary attention. In order to accomplish this a highly specialized system of forms is needed. These forms must provide for preliminary inspection of the plane in order to determine what work must be done, must ensure such a final inspec-



Night servicing under way in the Hexhangar service unit (Alhambra Terminal, Los Angeles) of Transcontinental and Western Air, Inc.

tion as will guarantee that all necessary work has been done, and must, when properly followed and filled out, give all pertinent information at all times to everyone concerned. The forms should be such that every operation can be traced to the man performing it, thus fixing the responsibility for every move made. They should make it possible to enter all data necessary to the proper servicing of the plane whether that data be collected at the main repair base, an intermediate depot, or in the air itself. Finally, these forms must be specialized to apply to the individual types of planes and engines under consideration.

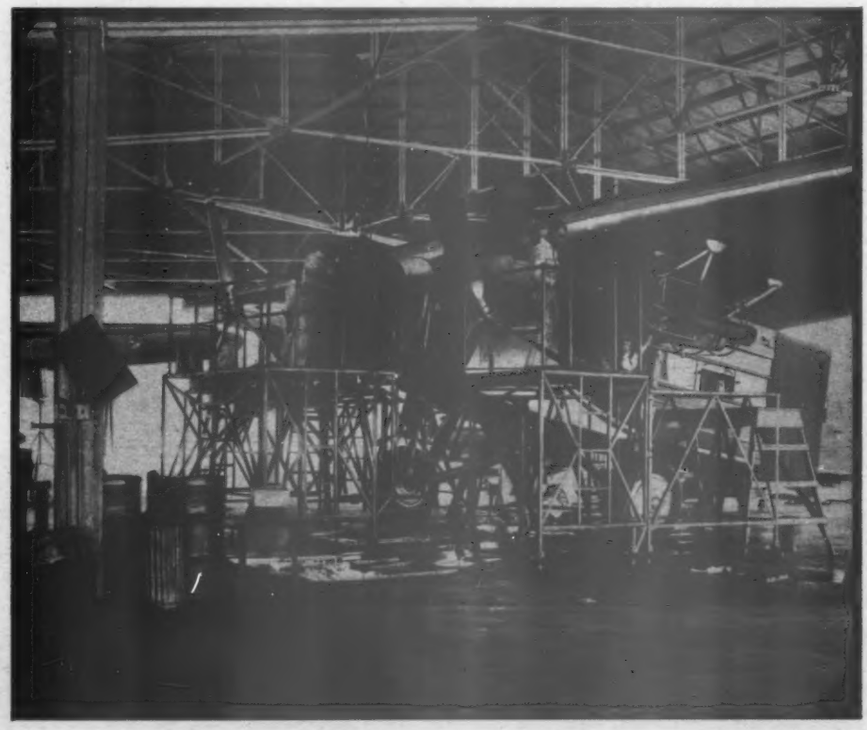
In general the routine inspection sheet and work form followed by the individual mechanic is laid out to cover the entire plane, including its engines, and it also usually provides for the flight report on the same sheet. There are some lines which prefer a separate flight card, filled out and filed separately. Some also use a more highly detailed form which lists the plane and each engine on a separate sheet. It is common practice to use a special form for radio equipment, another for inspection of instruments, and still another for the passenger cabin interior. Practically all forms are so arranged that the inspector can check items which require attention and the individual workman can initial the item when his work has been completed.

Where a combination routine sheet and flight report is used the co-pilot is usually charged with the task of preparing the report during the flight and turning it in to the service crew chief at the end of the run. When the routine inspection sheet does not accompany the plane a copy of the pilot's flight report goes to the crew chief and he makes appropriate notations on the routine work sheet. In any case the crew chief or an inspector makes a detailed inspection of the plane after each run, notes all routine and special servicing work to be done, and this, as completed, is initialed by the mechanic opposite the designation of work to be done. The sheet is signed by the crew chief after work is completed and he has made his final inspection, and is signed again by the pilot upon acceptance of the plane after he has inspected it and satisfied himself that it is ready for flight. Thus there is a definite fixing of responsibility and a threefold check upon the plane before it is again placed in service.

In assigning the work on a plane it is customary for the crew chief or chief inspector to confer with the chief engineer or superintendent of maintenance, depending upon the form of shop organization in vogue. If all work is routine it is usually done without delay, but if work of a special nature must be performed it is customary to consider the various factors involved in order to determine whether to bring in an emergency crew and perform the work at once, temporarily withdraw the plane from service, or, if the defect is a minor one, postpone the repair until the end of the next run in order to better fit the work into the service schedule. In any case these factors are considered with each plane and an outline of work to be done during the night is ready for the night foreman when he comes on duty. It may be said that most air transport systems now perform the bulk of servicing work at night. When the night foreman arrives on duty he confers with the chief engineer or superintendent, as the case may be, and together they outline a complete program of work for the night crew. In order that there may be no confusion in organizing and assigning work it has become common practice to make all orders written rather than verbal. Transcontinental and Western Air, Inc., provides special forms upon which to write all shop orders of any sort, even the most minor instruction.

There are two practices which are universal procedure with the major transport lines. The first is to keep equipment perfectly clean at all times in order to facilitate inspection. The second is to require that all mechanics consider themselves as inspectors also and constantly seek for hidden flaws or defects.

THE system of routine work forms used by Boeing Air Transport and by Pacific Air Transport, each a unit of the United Aircraft and Transport Corporation, is significant in that they are so simplified and consolidated that more than the ordinary responsibility for proper servicing is placed on the shoulders of the individual mechanic and crew chief. Pacific Air Transport uses a combined maintenance and flight report record sheet which is filled out in triplicate, one copy being filed at the point of departure, one at point of destination, and the original at the head office for master



Use of the special adjustable steel servicing stand developed by Transcontinental and Western Air in the Hexhangar service unit. The plane is a Fokker F-10.

records and pilot's payroll account. Routine work and inspection forms used by Boeing Air Transport differ somewhat from those of Pacific Air Transport. A daily airplane inspection report is filled out in duplicate and the pilot's flight record and report is kept on a separate card. One copy of the inspection form is kept in the plane's log book and the other copy is filed with the main office after completion of the work listed. Aside from the initialing of work done no signatures are required on this sheet except that of the pilot accepting the plane.

SOME special problems of servicing have been met by Air Ferries, Inc., operating a short-haul service across San Francisco Bay with Loening amphibions. Although this service is quite unique and the planes used are distinctly different than those used on the Boeing lines, Air Ferries has found it good practice to use a service form almost identical with that used by Boeing Air Transport. Air Ferries planes are in service each day from 8 a.m. to 6 p.m., flying on a 20-min. schedule over a route 6 mi. long with a trip flying time of but 6 to 8 min. This requires each plane to make from 30 to 70 landings per day, half of which are on the runways of San Francisco Bay Airdrome and the other half on the surface of San Francisco Bay, opposite the Ferry building. The water landings are often quite rough and the planes dock by climbing out upon a special floating dock under their own power. These conditions impose a very exceptional strain upon the engine, which must operate at maximum r.p.m. a large portion of the time.

In spite of these adverse factors it has been found practicable to keep the planes in service regularly by proper organization of the service department. Night servicing was first tried but it has been found to be better practice to service all equipment during the day, dividing the planes into morning and afternoon fleets. This practice provides a full service crew at all times during operating hours in case emergency repairs must be made on a plane in service.

One of the major servicing items is that of giving each plane a thorough washing with soap and water after each operating period. After washing the planes are rubbed dry and all exterior surfaces are then rubbed down with Calol polishing oil. Such treatment sends the planes out for each run with a fresh film of protecting oil and greatly lessens the deteriorating effect of contact with salt water. Other special measures of protection are to treat all exposed metal parts with waterproof machine grease and to paint all exposed wires with an asphaltum base paint. Special attention is paid to lubrication and rocker arm grease is changed every 20 hr. Spark plugs are changed often due to the shortcircuiting effect of salt encrustation from the salt water spray.

Some trouble results from water and small pieces of driftwood damaging the fabric on the underside of the lower wing panels, particularly close to the fuselage where water from the hull builds up against the wing, and it has been found necessary frequently to replace the covering on this portion of the wing.

Throughout all Air Ferries servicing, high-speed tools have been used wherever possible in order to speed servicing operations and place equipment back in service with minimum delay.

Service forms employed by T.A.T.-Maddux Airlines, now consolidated with Western Air Express to form Transcontinental and Western Air, Inc., are quite similar to those used by Pacific Air Transport. All T.A.T.-Maddux forms have applied directly to the servicing of Ford planes and the routine sheet carried two main columns, one devoted to work and inspection of engines and the other to the plane.

In connection with this maintenance sheet the T.A.T.-Maddux shop, at Grand Central Air Terminal, western division base, operated a large visual blackboard record of every plane and engine in use. In a vertical column at the left of the board were listed all planes in service, and opposite each plane listed there was a space for recording data on each of its three engines. A horizontal column extended across the board from each plane and engine listed giving in order the following data: time since overhaul of engine, daily time, date of last oil change and cleaning of oil screens, date of greasing rocker arms, date when magnetos were checked and oiled, date when valves were checked, date when pushrods were greased, propeller time to date, date of inspecting and cleaning fuel tanks and strainers, hours since spark plugs were changed, date when engine was changed, date when propeller was changed, total plane time, date of greasing and inspecting landing gear wheels, and date of inspecting landing gear. This board was kept up to date from day to day and thus provided complete information at a glance on the amount of servicing which had been given any particular unit. The entire shop has been moved from Grand Central Air Terminal to the Alhambra terminal of T. & W. A. and this blackboard system is being continued there at the present time.

Service procedure as followed by the western division of T.A.T.-Maddux Airlines was fairly typical of other organizations operating all-metal planes. The major portion of engine and accessory servicing is the same for metal planes as for equipment of the composite or Fokker type. The chief point of difference is in the manner of inspecting and methods of repairing the all-metal structure and covering. This requires the operation of a complete metal shop, which in the case of T.A.T.-Maddux was so complete that any repairs could be made on Ford airplanes except those requiring the use of major fuselage or wing jigs. This shop has been enlarged somewhat under the recent merger.

In addition to engine overhaul, shop equipment and metal shop equipment, the normal servicing equipment maintained by the metal-plane department of T.&W.A. consists of a complete stock room, tractors for shifting flying equipment, five moveable work stands, a dozen assorted step ladders built especially for working on Ford planes, two Ford jacks, one oil bowzer, and two battery charging sets. Under the T. & W. A. merger the equipment of both companies has been somewhat consolidated in the interests of efficiency.

When operating at the Grand Central Air Terminal base all Ford planes were serviced at night, being fueled at the gasoline pit on the service line before going into the hangar for servicing, and then being completely greased and oiled by the night crew apprentice. All oil changing, checking of valves, greasing of rocker arms, cleaning of oil strainers, magnetos and engines, testing of brakes, tires, wheels, and controls, and any necessary engine changes were performed by the night crew. Each morning a flying test was given each plane before it was placed on the line as being ready for service. In order that all shop equipment might be efficiently utilized, repair and overhaul work was sometimes planned for performance at night, in which case the engine overhaul or metal shop crew would be held over. All mechanics were assigned numbers and they placed these numbers,

rather than their initials, opposite each item of work done. Special propeller servicing consisted of a careful inspection after each flight, and after 300 hr. of operation the propeller was removed and blades and hub etched and examined with a magnifying glass for defects, a practice followed by all major operators. In all cases a detailed record was kept of each blade and hub.

A detailed list of the routine servicing work performed at the Glendale base field is as follows: engine cleaned, engine bolts and engine mount bolts inspected; valve clearances checked, valve springs inspected, rocker arms greased and rocker boxes packed with grease, push rods inspected and greased; priming lines inspected, Lunkenheimer inspected, carburetor and controls inspected; gas lines and valves inspected; propeller hub and hub bolts checked; horizontal stabilizer adjustment checked, vertical stabilizer and fittings checked; elevator, tail wheel, landing gear, and fittings inspected; wheel retainers and wheels inspected, air in all tires checked, wheel spokes tested and wheels and fittings greased; control column and fittings examined; switches and lights examined and control box and generator checked; fuselage inspected throughout.

This work is performed at the end of every run and all additional work is classified as repairs or overhaul and is scheduled by the chief engineer accordingly. Essentially the same system is in effect under the merger.

Western Air Express, recently merged with T.A.T.-Maddux to form T. & W. A., has developed one of the most highly organized service departments in the air transport industry, with an exceptionally well worked-out system of forms. A separate service form is used for the plane and for each engine, with a separate flight sheet carried by the pilot. An additional inspection sheet covers the wing in detail and is used in connection with a thorough wing inspection performed every 30 days. The inspector marks on the chart the section of the wing requiring attention and checks the individual items on which repairs are to be made.

A special engine record sheet is used when the engine is approaching the overhaul period to indicate the total engine time, time on last ten trips, highest and lowest cylinder head temperatures, compression chart of each cylinder, and oil consumption for the first ten as compared with the last ten trips. A compression chart of each engine is made following each run after the engine has 250 hr. of time since overhaul, by inserting a pressure recording instrument in a spark plug hole of each

Left: Maintenance and flight report form as used by Pacific Air Transport illustrating the simplified or concentrated type. Below: The daily airplane inspection report of Boeing Air Transport. This is also illustrative of the short form. Right: Wing inspection sheet of Western Air Express is used for thorough wing investigation every 30 days.

MAINTENANCE and FLIGHT REPORT

PACIFIC AIR TRANSPORT

Station.....

PILOT'S REPORT

Date.....19.....

(To be filled out by Pilot)

Plane ..... Time to date since overhaul.....
Motor No..... Time to date since overhaul.....
Prop. Blade No..... Time since etching.....
Prop. Blade No..... Time since etching.....
Prop. Hub No..... Time to date.....

This flight

Total time since overhaul.....
Total time since overhaul.....
Total time since etching.....
Total time since etching.....
Total time.....

PILOT'S NOTES: .....

Pilot

INSPECTION REPORT

LIVES MAY DEPEND UPON THE THOROUGHNESS OF YOUR WORK

	Initial when work is done		Initial when work is done		Initial when work is done
D Clean motor		D Motor covered when not in use		D Inspect flares & controls (uncontested before flight)	
D Inspect carburetor & controls		D Check valve clearances		D Inspect navigation lights	
D Inspect gas lines & flow		D Oil magnetos		D Inspect landing lights & leads	
D Inspect priming lines		W Check spark plug gaps & clean		D Inspect fuel cocks	
D Inspect valve springs		W Check spark plug insulation, etc.		D Inspect all throttles	
D Inspect valve clearances		W Tighten all motor bolts & safety		D Inspect starter controls	
D Inspect push rods		W Clean oil screens or filter		D Inspect cowl position control	
D Grease rocker arms (25 hrs.)		W Tighten propeller hub & safety		D Inspect dash, manifold & cabin lights	
D Inspect & clean generator (brushes, commutator, oil & connections)		W Tighten propeller hub bolts & safety		D Inspect all switches	
D Inspect & clean starter (brushes, commutator & connections) (Do not lubricate starter.)		W Check propeller alignment		D Inspect instruments and windshield	
		W Clean oil sump & gauge lines		D Check hand & pressure pumps (Are they filled?)	
		D Inspect fuel tanks & connections (leaks, etc.)			
D Inspect gen. control box		D Inspect wing wires & fittings		D Inspect safety belts	
D Check magnetos		D Inspect & oil horiz. stab. adjustment		D Check first aid kit	
D Check magneto points		D Inspect vertical stabilizer & fittings		D Clean cockpit & cabins	
D Check magneto leads		D Inspect & oil tail post, skid & axle		D All inspection doors o. k.	
D Check wiring for broken insulation, etc.		D Inspect tail skid shock cord & shoe		D Inspect all fabric	
D Check booster mag		D Inspect wing fittings		D Inspect cabin doors	
D Inspect, tighten & safety spark plugs		D Inspect wing struts & fittings		D Thermos bottles filled	
D Inspect engine fuel pump & connections		D Inspect brakes & controls		D Refine cans o. k.	
D Inspect hand fuel pump & connections		D Inspect landing gear axles, struts & bolts		D Test air pressure and inspect tires	
D Inspect oil tank & connections				D Inspect radio equipment	
D Inspect oil pump, radiator & connections		D Inspect elev units		W Inspect wings throughout	
D Inspect fuel relief valve		D Inspect wheel retainers & streamlines		W Inspect fuselage throughout	
D Clean fuel strainer		D Inspect & oil aileron control wires, pulleys, hinges, fittings & surfaces		W Inspect wheel spokes	
D Inspect propeller blades				W Grease wheels	
D Inspect all motor bolts & safety		D Inspect & all elevator control wires, pulleys, hinges, fittings & surfaces		W Clean ship thoroughly	
D Inspect exhaust pipe bolts & safety				W Oil at proper level in also units	
D Inspect intake pipe bolts & safety		D Inspect & oil rudder bar, wires, hinges, fittings & surfaces		W Inspect hoses, controls & connections under fuselage	
D Inspect battery & connections					
D Inspect motor cowling & safety		D Inspect & oil control stick & fittings		W Inspect tool kit (any items missing?)	

(Symbol: D—Daily; W—Weekly.)

Date of last weekly inspection.....19.....Labor hours (time and by whom).....

Gas.....Gals. Oil.....Qts. Oil drained at.....Station. Total motor hours when drained.....Motor flushed.....

Shop remarks (motor change, repairs, adjustments, materials used, etc., to be noted here).

.....

.....

If above inspection not completed, explain why.....

Inspection notes .....

Inspected and passed by:

Accepted.....
Pilot

.....
In Charge

(Do not open motor up until oil temp. has reached 100° F. (40° C.) NEVER run motor at full throttle on ground for more than a moment.)

FLIGHT RECORD

(To be filled out at destination) Date.....19.....

From..... To..... Left..... Arr'd..... Weather.....
From..... To..... Left..... Arr'd.....
From..... To..... Left..... Arr'd.....
From..... To..... Left..... Arr'd.....TOTAL TIME.....Hrs.....Mins.

Oil Pressure Start.....Finish.....Ave.....Volts.....Amps.....Temp. Start.....Finish.....Aver.....

R.P.M. Ground.....Max. Air.....Ave.....Alt. Max.....Ave.....

DELAYS (and why)-- .....

.....
Pilot

Total flight miles allowed: Day.....Night.....

Detailed report of any forced landings (Form No. 68-P), accidents to ship or motor (Forms Nos. 81-P and 81-AP), must accompany this form.

THIS COPY: To be mailed Oakland by Pilot for payroll record.

BOEING AIR TRANSPORT, INC.

DAILY AIRPLANE INSPECTION REPORT

PLANE..... FIELD.....

ENGINES

LEFT	CENTER	RIGHT
Prop	Prop	Prop
Mount	Mount	Mount
Cowling	Cowling	Cowling
Shutters	Shutters	Shutters
Controls	Controls	Controls
Pulleys	Pulleys	Pulleys
SERVICE	SERVICE	SERVICE
Push Rods	Push Rods	Push Rods
Bayonets	Bayonets	Bayonets
Gaskets	Gaskets	Gaskets
Clams	Clams	Clams
Bolts	Bolts	Bolts
Plugs	Plugs	Plugs
Inserts	Inserts	Inserts
Gaskets	Gaskets	Gaskets
VALVE MEC.	VALVE MEC.	VALVE MEC.
Valves	Valves	Valves
Guides	Guides	Guides
Springs	Springs	Springs
Clearance	Clearance	Clearance
Rockers	Rockers	Rockers
Rockets	Rockets	Rockets
Greased	Greased	Greased
Packed	Packed	Packed
Exhausts	Exhausts	Exhausts
CYLINDERS	CYLINDERS	CYLINDERS
Cylinders	Cylinders	Cylinders
Flanges	Flanges	Flanges
Studs	Studs	Studs
Safety Wire	Safety Wire	Safety Wire
Gaskets	Gaskets	Gaskets
Manifolds	Manifolds	Manifolds
Glands	Glands	Glands
IGNITION	IGNITION	IGNITION
Magn.	Magn.	Magn.
Leads	Leads	Leads
Terminals	Terminals	Terminals
Bonding	Bonding	Bonding
Booster	Booster	Booster
Ground	Ground	Ground
Brackets	Brackets	Brackets
ELECTRIC SYSTEM	FUEL SYSTEM	OIL SYSTEM
Generator	Tanks	Tank
Starter	Sight	Straps
Battery	Left	Vent
Terminals	Gravity	Lines
Bonding	Wobble	Pump
Volts	Pump Ck	Hose
Amps.	Lines	Change
Lights	Hose	Drain
Control box	Change	Safety
	Flushed	Serviced
	Safetied	
	Carburetor	

PLANE	
LANDING GEAR	
Axles	
Struts	
Glues	
Wheels	
Tires	
Pins	
Brakes	
Controls	
Fittings	
Cotters	
FUSELAGE	
Cowling	
Mail Pits	
Cabin	
Cockpits	
Flares	
Windshield	
Instruments	
Stab Controls	
Turnbuckles	
Busts	
EMPENNAGE	
Stab	
Fin	
Rudder	
Elevators	
Hinges	
Horns	
Wires	
Braces	
Stab Spool	
Shock	
Skid	
Shoe	
Safeties	
Wheel	
WINGS	
Wires	
Struts	
Bolts	
Fabric	
Ailerons	
Hinges	
Bolts	
Cotters	
Lights	
CONTROLS	
Surfaces	
Wires	
Pulleys	
Alignment	
Buckets	
Safety	

SERVICE

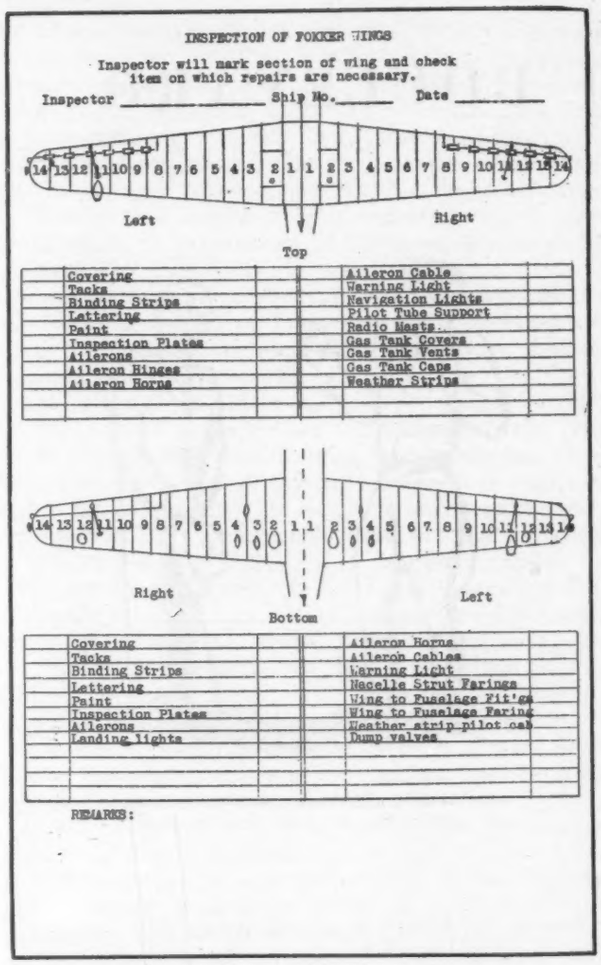
Gas Gals. ..... Oil Drained ..... Tool Kit .....
Oil Qts. ..... Oil Filled ..... Log Posted .....

Inspection and repairs will be made in order listed; Chief Mechanic will check with red pencil before items where special work or inspection is to be done. Mechanic must complete work, inspection and initial after each item and have Chief Mechanic's authority before starting another job.

Repairs and adjustments made before flight:—

WORK DONE	BY	DATE	WORK DONE	BY	DATE	REMARKS Use other side

Test Run by Mechanic.....
Accepted.....Pilot Date.....19.....



INSPECTION OF FOKKER WINGS

Inspector will mark section of wing and check item on which repairs are necessary.

Inspector _____ Ship No._____ Date _____

14 13 12 11 10 9 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Left Right

Top

	Covering		Aileron Cable
	Tacks		Warning Light
	Binding Strips		Navigation Lights
	Lettering		Pilot Tube Support
	Paint		Radio Masts
	Inspection Plates		Gas Tank Covers
	Ailerons		Gas Tank Vents
	Aileron Hinges		Gas Tank Caps
	Aileron Horns		Weather Strips

14 13 12 11 10 9 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Right Left

Bottom

	Covering		Aileron Horns
	Tacks		Aileron Cables
	Binding Strips		Warning Light
	Lettering		Nacelle Strut Farings
	Paint		Wing to Fuselage Fit'gs
	Inspection Plates		Wing to Fuselage Faring
	Ailerons		Weather strip pilot cab
	Landing lights		Dump valves

REMARKS:

cylinder and pulling the engine through the compression cycle by hand and with the electric starter with the ignition off. In addition to the compression chart, oil consumption is carefully checked at 100 and 200 hr. after overhaul and then every 50 hr. thereafter until the engine is overhauled.

All western division maintenance of Transcontinental and Western Air is performed at the Alhambra terminal field, Los Angeles. Planes operated include Ford, Fokker, Boeing, Loening, Stearman, Douglas, and others. Total planes in use are approximately 40 and total engines more than 100. The maintenance department which keeps these planes in service consists of approximately 175 men who are on duty in three shifts—24 hr. a day.

Routine maintenance consists of four steps: a routine servicing at the end of each run, a re-check at intermediate stop-over points away from the home base, a valve check every 24 hr. of flying time, and a push-rod pull job every 72 hr. The valve check includes routine inspection and the rod pull includes a valve check.

TAKING a normal maintenance cycle as followed by Transcontinental and Western Air we start with the routine inspection and check which is performed after every run and on an average of about every 6 hr. of flying time. All spark plugs are removed, cleaned, adjusted to a gap of 0.012-0.015 in., tested and replaced; oil and fuel line hose clamps are tested, oil and gasoline sumps are drained and cleaned, and the fuel strainer examined; all wire connections are examined for tightness; controls are checked throughout and special attention is paid to the possibility of frayed control wires; wheel brakes are tested for tension by jacking up the wheels and adjusting until the wheel will just move freely with no pressure on the pedals; the tail wheel assembly is cleaned, examined and greased; tires and landing-gear are inspected, a pressure of 65-70 lb. being maintained in tires. In addition to these items the inspector completely examines all parts of plane and engines and checks any additional work.

Following the routine inspection a valve check is given at approximately every 24 hr. of flight time and includes the routine inspection plus the following items: oil is drained, sumps cleaned and tanks refilled; fuel strainers are cleaned; grease is washed from rocker boxes with cleaning solvent and a pressure air gun; valve stems are adjusted to a clearance of 0.010 in. and rocker boxes are refilled with high pressure grease; the propeller nut is checked for tightness; spark plugs are replaced if necessary; the magneto breaker point assembly is removed, cleaned, and adjusted if necessary. A complete inspector's report is made as in the routine inspection.

A rod pull is given about every 72 hr. of flying time and includes the valve check plus the following items: valve push rods are removed, cleaned, and checked for trueness by rolling over a flat surface plate; defective rods are replaced; housings and rocker boxes are thoroughly cleaned; push-rods are replaced and lubricated with high pressure grease on the upper end and graphite on the lower end; push-rod housings and rocker boxes are packed by hand with high pressure grease after which additional grease is forced in through the Zerk fittings on the rocker arm bearings. A total of about 15 lb. of grease is packed into each engine on this operation. Before it was made standard practice to completely pack the rocker boxes with grease, rod pulls were being made every ten hours. Now they average 96 hr., as previously stated. New gaskets are installed on rocker box covers and push-rod housings and additional work listed by the inspector is performed.

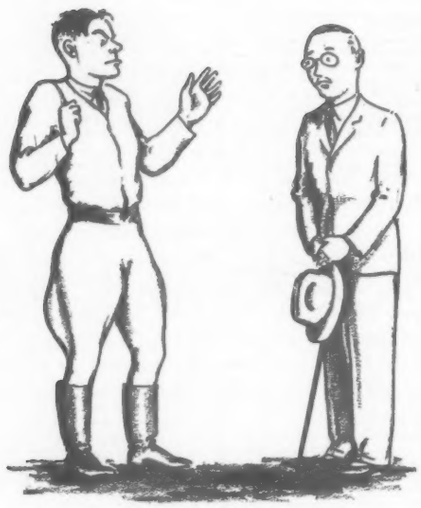
Servicing of individual units by T. & W. A. is fairly typical of good practice among air transport operators: electric starters are overhauled at the same time as the engine; batteries are recharged after every trip; propellers are inspected in detail on a report from the pilot or at the time of engine change; lights are checked after every trip but are run until they burn out, spares being carried in each plane; radio equipment is tested after every run by means of special meters which check each tube against on outside power source, after which each tube is checked against the plane's battery; engine instruments are normally overhauled every three months; the tachometer is tested after 120 hr. of operation, bank and turn indicator every 300 hr., navigation instruments twice a year and compasses every three months.

Mechanical maintenance has reached a high degree of perfection as a result of careful attention to detail. Improvement is to be expected, however, in the speed and economy with which service operations are performed. This will be made possible by the gradual development of more highly specialized service methods and tools. Such a process of development will add to the reliability of present servicing while reducing costs within the shop itself in addition to effecting material economies through keeping planes in the air for a greater percentage of their life.

FROM HANGAR TO BOULEVARD

By R. Stuart Murray

Some airplane sales suggestions from the yacht broker and the custom-built automobile distributor



"The salesman . . . must not create an impression that he—as a man—is different or more 'daring' than his prospect."

WITHIN the past two years several of the larger aviation corporations established airplane showrooms on various strategic boulevards of our larger American cities, believing that by bringing the product within easy reach of the man in the street, they would increase their sales.

Several of these showrooms were truly magnificent—and indeed could well be described as "salons," yet—in back of the elaborate and beautiful surroundings, and even to back up some very substantial products in the form of airplanes—few of these organizations have had the foresight to equip themselves with a type of floor salesman who by experience is qualified to understand and put into effect the "technique" of show room sales in the price range of the airplanes offered.

To elucidate let us make a few comparisons. Taking an airplane as a transport vehicle at a cost of $15,000-20,000, let us compare its sales possibilities with (a) the imported motor car at the same price and (b) the cruiser yacht of similar value. All of these commodities are now offered for public consideration through the medium of metropolitan show rooms. All of these three forms of vehicular transportation, due to required care and built-in quality, are manufactured on a small production basis, because of the demand and in most instances for semi-custom-built features.

In the case of the imported motor car, the purchaser, by necessity a man of wealth, makes his selection and purchases a foreign built motor car solely because at its price and due to its distinctiveness, he is assured of having an "individual" car and an outward sign of his affluence. Very few people who buy these cars are willing to pay $10,000 more than the cost of the finest domestic cars solely because they believe them more mechanically perfect. In the selection of such a car the purchaser is guided by further personal requirements, such as speed, power, riding qualities and body design. In no case does the element of commercial utility enter into his consideration, although in some cases a submerged desire to "put on the swank" for business reasons is apparent.

Secondly, we will consider the yacht—day cruiser—or marine commuter. Again the commercial usefulness of the vehicle has no bearing on the case, although as a medium of entertainment it is continually used for indirect business purposes.

Now we shall consider the airplane. At the start, it is apparent that the plane has one vitally outstanding sales argument not possessed by its sister vehicles of land and water. It can be most successfully used for straight commercial purposes of transportation and advertising. It can serve also as a medium of business entertainment and at the same time be an instrument of pleasure. From a strictly commercial point of view the problem of sales has been covered numberless times by adequate articles on the subject. In my opinion the presence of an "in town" showroom is of much material help in getting the busy executive to look the plane over. The procrastination in going to the ever unhandy airport is one of the present obstacles in getting the prospect who is not personally sold to see the airplane. The airplane showroom has no more handicaps than those of the motorcars and speedboats.

In support of this, let us review the life of the average Mr. X., with whom we must expect to do business. We will find him affluent. In his business life he is an important executive of one or more large industrial or commercial organizations. He is in his forties—still young and active socially and in business. In his off hours he has, for years enjoyed yachting in season, and in his daily travel he uses the finest car that his position proportionately entitles him to have. He has a town house and a country estate. He is a clubman and a sportsman. For business and for pleas-

ure he does considerable entertaining. He is accustomed to paying in cash for what he buys and demands exactly what he wants. He has become accustomed to owning, using and maintaining automotive vehicles and the maintenance cost does not alarm him.

For the simple reason that the aircraft industry has not known how to appeal to Mr. X., the distribution of some of our largest aircraft manufacturers is now in the hands of experienced and long established yacht brokers, who thoroughly do understand him.

Yacht captains or chauffeurs are not maintained to sell in their respective lines—they only demonstrate when the time is ripe—leaving the salesman free to discourse with his customer.

The salesman should be one who is capable of conducting himself in any social or business circle. He should in appearance and training be a gentleman, since those with whom he will primarily deal will be likewise, with a few exceptions. He should be a convincing conversationalist and must stand ready to "sell" aviation to the feminine members of his prospect's family.

He should be capable of discreetly ascertaining his prospect's business travel requirements and his social and sports habits. He should be capable of sizing up an inquirer and ascertaining quickly the value of the apparent casual inquiry. Since he is dealing with an individualistic class, he should in turn, be capable of individualistic vision. He will gain his customers' confidence immediately if—in effect—he can talk the same language grammatically and literally.

If his particular bent is in making and developing contacts he should be encouraged in that field—and the sales manager should assume the brunt of handling the actual closures. Since much of the salesman's work will necessarily entail social contact in one form or another, he should be allowed to maintain the social platform of relations with his prospect. Some excellent contact men are poor salesmen—and vice versa.

And what of the sales manager? He, in a few words should be primarily a psychologist and should be chosen from a list of successful foreign car or yacht sales managers. He should not be accustomed to the fast pace of cheap car sales. He should be a good merchandiser and a sales strategist—a visualizer capable of seeing the import that may only appear between the lines of his salesman's reports.

Mr. X has an important younger sequel whom we will call Mr. Y. In this latter case many angles are comparable with his senior but Mr. Y, being young enough to participate in the more active sports himself, will often seek diversion in flying himself—for business and for pleasure. He is the young business executive who is in a position to influence his seniors in many progressive decisions. He and Mr. X are the business men whom we must cultivate earnestly at this time instead of the fickle public-at-large. The reasons are multifold. Both of these men are vital to us now. They buy our stocks, patronize our airlines, buy our planes and consume our accessories. They are our only market of today because, as in the early days of the motor car, they represented the only class that could seriously afford the possession of an automobile and all that went with it.

"Only of recent years has the boating industry been able to surmount fear as a point of sales resistance."

THE oft heard complaint of the airplane sales manager—"we're up against it because we can't wheel a demonstrator up to the door" is obviously weak. The boating industry has always had the same problem. They counteract it by efficient "idea" selling in the salon and interest the prospect, if he is judged a valued one, to the point where the next step—a demonstration, is not only logical to him but actually desired. The salesman's knowledge of competitive ships must be complete, but he must not create an impression that he—as a man—is different or more "daring" than his prospect.

Again the argument comes up that boat sales are easy because "everybody will ride in a boat." Permit me to say that only of very recent years has the boating industry been able to surmount fear as a point of sales resistance. When the first V-bottomed, high-powered speed boats appeared we had to sell safety. We had to convince people that the day of the old round-bottomed boat that rocked on the slightest provocation was over—and that it was at last possible to speed along at 40 to 50 m.p.h. on fairly rough water without any chance of the boat turning over. We had our hands full getting the more mature members of the fair sex, who often had a grip on the purse strings, to ride in a boat.

High-power salesmen have no place in the aircraft industry where public contact is to be made. Rather they should be of the young executive class—on a drawing account basis with ample opportunity to earn at least $10,000 a year. The men selected should be chosen with this figure as their minimum personally required income. Every airplane sales room should have a technically trained pilot on hand, should the prospect be interested in discussing the technical features. Under all conditions the primary factors rest in supplying a sales personnel adequate to the type of clientele aviation must depend upon for some years to come.

ENGINE SERVICING AND SERVICE ORGANIZATIONS

By Kenneth J. Boedecker

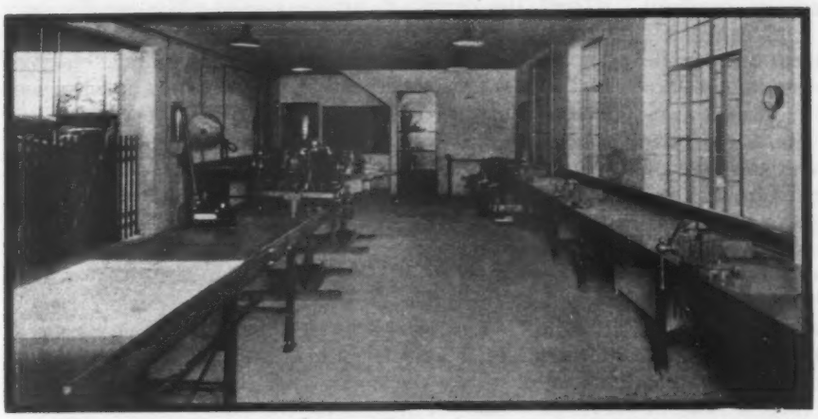
General Service Manager
Wright Aeronautical Corporation

The problem of engine maintenance is ever present to every aircraft operator, whether he be doing his own work or turning it over to a service station. For the small operator, in fact, the question of the length to which he can profitably go in installing his own servicing equipment is a constantly perplexing one. This article is written from a long experience with engines in the field and in the shop, and from observation of all the ills to which they can fall heir. The author naturally draws his particular illustrations from his own experience with Wright engines, but his general conclusions will apply to any established type.

ACTUAL servicing of aircraft engines begins at the factory, for every engine is subjected to a period of running of from four to six hours at gradually increasing power, the last two hours being run at nine-tenths rated load, which is well in excess of the normal load at cruising speed. After this run, each engine is completely dis-assembled, thoroughly washed, and minutely inspected for possible flaws. It is then rebuilt and again placed on the test stand for its final test, which consists of a one-hour warming-up period, then one-half hour at nine-tenths rated power and one-half hour at full rated power. During these tests the engine is carefully inspected for oil leaks, gasoline consumption, oil consumption and temperatures, and smoothness. If any of these items do not come within specifications, the error is corrected and an additional run made to check the correction. As soon as the engine has satisfactorily passed its final test it is sent to the shipping room, where it is given a thorough outside inspection that corresponds quite closely to the regular periodical inspection of engines in actual service required by the Department of Commerce; that is, the oil strainers are removed, cleaned and inspected; carburetor air cleaner is removed and cleaned, rocker bearings greased, clearance between rocker rollers and valve stems checked, spark plugs inspected, magneto points and magneto synchronization checked, safety wires and locks checked throughout, and tightness of all bolts and nuts checked. The engine is then slushed with oil to prevent rust, and packed for shipment.

It is implied above that all aircraft engines are subjected to the foregoing tests and inspections, but this statement should be qualified. All Wright and Curtiss engines are treated in this way, and others are undoubtedly tested in a very similar fashion.

The servicing or complete overhaul of engines after their normal 300 hr. of operation is closely akin to the tear-down inspection and subsequent test which every new engine receives. Of course, during the 300 hr. of operation, there must be many service inspections to insure uninterrupted and smooth running and these matters will be taken up in a subsequent paragraph. The 300 hr. of normal operation may be likened to the original six-hour test of the new engine, the tear-down inspection and final acceptance test after that amount of running and a major overhaul being identical to that for the new engine. The tear-down inspection, overhaul, and test may be done at the authorized service station or at the repair base of an operator. In any case it should closely follow factory procedure and great care should be exercised in keeping all parts free from dust and dirt throughout the period that individual parts are undergoing inspection and re-assembly. Individual rolling parts racks, large enough to accommodate all of the parts of the particular engine being inspected, should be available. As the engine is torn down, the parts should be carefully distributed on the parts rack and upon complete dis-assembly, rolled to the wash stand. Care should be taken to note any unusual condition of the parts as the engine is being torn down and prior to washing. Unusual conditions should be called to the attention of the inspector. After washing all parts with a gasoline spray the parts rack should be rolled to the inspector who should inspect each part, making notes of its exact condition and stating whether or not the part should be replaced. Inspection is made in strict accordance with the clearance charts and table of limits which appear in all Wright instruction manuals. Micrometer measure-



The efficient overhaul shop of Curtiss Flying Service at Memphis, Tenn. Assembly benches are at the right, welding benches, left; and stock room window in the rear.

ments are made throughout to determine all clearances. In the case of factory overhauls the "Maximum Allowable Wear" column is disregarded and all parts are brought within manufacturing limits. The accompanying sheets show the inspection forms used at the Wright Aeronautical Corporation's service division. Similar forms are used by most authorized service stations. Accessories, such as magnetos, starters, and carburetors, should be turned over to a specialist for checking and repair. After overhaul has been completed, the accessories should be returned to the proper parts rack. The inspector should remove from the parts rack any parts which are not fit for further use, issue a requisition for necessary replacement parts and deliver the parts rack to the assemblers either with the new parts or the requisition covering them. The unfit parts should be tagged with the engine number, owner's name, and reason for rejection and held for customer's inspection or information, and disposition. It should be unnecessary to hold rejected parts longer than thirty days.

THE engine, when re-assembled, should be placed on the test stand and given the final acceptance test unless it has been necessary to replace major parts, in which case sufficient teardown should be made to inspect the replacements. If such teardown disturbs timing or involves possible oil leaks a short check run should be made to determine that everything is satisfactorily adjusted.

Too much stress cannot be laid on the matter of keeping dis-assembled parts in neat order and free from dust and dirt, because there is nothing that causes loss of confidence in a repair depot as much as seeing parts strewn here and there, exposed to grit and dirt, and the mixing up of parts belonging to one engine with those of another. It makes little difference whether such things are seen by engine owners visiting a service station or a transport lines' passengers visiting a repair depot, the result is the same—namely, loss of confidence in any work performed at the disorderly repair shop.

It is gratifying to note that the majority of repair shops are actually cleaning house and are presenting a far more respectable appearance than heretofore. Those bases which do not follow this example will of necessity have to close their doors, since aircraft owners and passengers will not patronize service stations or transport lines that tolerate carelessness in any degree.

The proper servicing of engines between overhaul periods is extremely important and is the direct responsibility of the operator. Every engine should receive a periodical inspection at 10, 20, or 30 hr. intervals, depending to a great extent upon the kind of service to which it has been subjected, the grade of fuel and oil which are used, and the treatment accorded by the individual pilot.

The kind of service to which an engine is subjected might be divided into two general classes—military and commercial. These two classes might be sub-divided into many others. However, for the purposes of this article only three sub-divisions will be considered and these will be on the commercial side, although many military uses closely parallel the commerical uses. Stunt flying and racing will not be considered.

First there is the service that requires full-throttle running close to the ground with frequent starts and stops, as in crop dusting and kindred enterprises.

Second, the service which, due to antiquated equipment, requires almost full throttle operation to maintain schedules set by the increasing demands for faster transportation.

Third, the service which is possible with up-to-date aircraft which have been designed to give the desired cruising speed at a normal throttle opening, allowing plenty of excess power, in case of emergency.

The affect of poor fuels and oils on the servicing and life of an engine is felt under all conditions noted above but to a more marked degree in cases one and two.

In the first case it is quite necessary to give very frequent attention to the change in oil, checking of tappet clearances, cylinder compression, spark plugs, magneto points and cleaning of oil screens. If low grade fuel and oil are used or if the mixture control is used injudiciously, serious engine difficulties are almost bound to ensue. Even with high grade fuel and the use of full rich mixture setting (the mixture should never be leaned out in this kind of service) engines being used in such service should receive a careful check every 10 hr., a top overhaul every 100 hr. and complete overhaul every 200 hr. Operations of this kind are the hardest to which an engine can be subjected because of the frequent heating and cooling of the engine while flying wide open close to the ground and the quite sudden shutting off of the motor while the plane is being re-loaded with insecticide, fuel and oil.

The second case is almost as hard on an engine as is the first case, except that there is less variation in engine temperature because there is less starting and stopping and the operation is generally carried on at higher and cooler altitudes. Also the use of the mixture control is less apt to cause overheating of the cylinders and the possible burning of valves, pistons or cylinders and the sticking of piston rings. As in the first case, there is great danger that the use of low grade fuels and oils will enhance the possibility of the troubles mentioned above. Engines subjected to such operation should receive a careful check including oil change every 20 hr.,

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a top overhaul every 125 hr. and a complete overhaul every 250 hr.

Engines which are covered by the third case, while not being subjected to the easiest conditions known, are not abused as are the engines in the first two cases mentioned. As a rule such operations require that the engine be run at wide open throttle only at the time of taking off—reducing the engine speed gradually as the flying speed increases and finally setting the throttle to give an engine speed of approximately seven or eight-tenths of its rated speed. Low grade fuels and oils are not as detrimental to engine life in such operations but nevertheless should be shunned. A great deal of damage can be caused by low grade fuels and oils during the few minutes of full throttle running for take-off and climb to altitude in normal operations. Engines in this kind of operation should receive a careful check including oil change at least every 30 hr., a top overhaul every 150 hr., and a complete overhaul every 300 hr.

It is quite true that the majority of aircraft engines which are being built today by the various manufacturers will operate satisfactorily with less frequent checking and for greater periods between top overhauls and complete overhauls than has been indicated above, but owners and operators are too prone to extend the checking and overhaul periods to dangerous limits, only because the engine is operating satisfactorily and has given no indication of needing attention. Many complete engine "washouts" could have been prevented, had proper attention been paid to systematic and frequent checks, top overhauls, and complete overhauls. Such overhauls are the best insurance against disaster or expensive damage.

In many cases the engine owner or operator unjustly demands that the manufacturer supply a new engine or rebuild the damaged engine gratis. The trouble may have been caused by any one of several conditions or a combination of conditions such as poor lubrication, poor fuel with resulting detonation and excessive heating, poor maintenance or abuse by the pilot. Proper checks, top overhauls and complete overhauls at regular intervals will generally bring to light any defects or maladjustments which can easily be corrected before any real damage is done. A twenty-hour check would bring to light blowing valves, weak piston rings, poor spark plugs, foreign matter in oil (which would indicate that a more complete inspection is needed) and excessive friction. A top overhaul would bring to light any possible piston defects, indication that the lubrication is incorrect or indication that for some reason the pistons, valves and cylinders have been running too hot.

Form No. 300 — WRIGHT AERONAUTICAL CORPORATION — Engine No.
2/17/30 — Paterson, N. J. — Model
S.D.C.No.
Page 1 — SERVICE DIVISION INSPECTION REPORT — Date

Date Received_____ Date Checked_____ Date Inspected_____ Date Promised_____
Name of Owner_____
Flying time to date_____ Flying time since last overhaul_____
Number of previous overhauls_____ Was log book received with engine?_____
General External Condition of Engine_____

Reason for return to factory (Give full details of any failures)_____

EQUIPMENT RECEIVED WITH ENGINE

Starter cover plate_____ Carburetor Elbow_____
Fuel Pump: Type_____ Make_____ Serial No._____ Alemites_____
Fuel Pump Cover Plate_____ Uniflows_____
Gun Drives: _____ R.H._____ L.H._____ Oil Drain Pipe_____
Gun Drive Cover Plates_____ Oil Suction Pipe_____
Propeller Hub_____ Booster Terminal_____
Propeller Nut Inner_____ Outer_____ Ground Terminal_____
Carburetor Controls_____ Standard_____ Special_____ Priming System_____
Magneto Adv.Rods_____
Air Heater_____ Hot Spot_____ Air Cleaner_____
Starter: Type_____ Make_____ Serial No._____ Spark Plugs_____
General Condition of Starter_____

Is Starter In Operating Condition?_____
Is Starter Complete? (List All Shortages)_____

RECEIVED SHORT: _____

SPECIAL EQUIPMENT: _____

RECEIVED IN: Standard Domestic Box___ Standard Export Box___ Standard Cradle___
Customer's Cradle_____ Customer's Box_____ Customer's Crate___

MAGNETOS: Make_____ Type_____ Numbers: R.H._____ L.H._____
CARBURETOR: Make_____ Type_____ Number_____

AFTER DISMANTLING: TYPE OF STARTER DOG_____
OTHER PARTS FOUND MISSING AFTER DISMANTLING_____

GENERAL CONDITION INSIDE OF ENGINE BEFORE CLEANING_____

APPROVED_____ INSPECTOR_____

Page 1, showing results of preliminary appraisal of engine condition as received.

MOST aircraft manufacturers are willing to assume responsibility for defective material and workmanship and will render an honest opinion as to the cause of failures. In the case of failure of Wright engines, if inspection at the plant indicates that failure is due to defective material or workmanship, and the failure has occurred during the warrantee period, it is and always has been the policy of the company to make good at the plant or through its distributor and service station organization throughout the country or through its own field personnel, who are continually covering the country visiting service stations, military aircraft bases, aircraft manufacturers, airline operators, and individual owners for the purpose of instructing mechanics in the maintenance and overhaul of Wright engines.

The company does not delegate to its service stations, distributors or service men, the right to make gratis replacements or render free service except in rare instances which are covered by special memoranda or service station bulletins. However, they are required to study impartially every complaint and if in their judgement the company is at fault, a full report is forwarded to the factory for its considerations. In cases where causes of failure are obvious to the company and are covered by warrantee, immediate authorization is granted the service station to correct the difficulty at the expense of the company. The service station is reimbursed through the distributor for the material used, upon receipt and subsequent inspection of the replaced parts. Where a doubt as to the cause of difficulties exists in the mind of the service stations manager, or if he is thoroughly convinced that the difficulties are no fault of the company, it is required that he assume full responsibility for the collection of charges from the customer. Should there be a legitimate complaint from the customer as to charges for labor or parts, the matter should be taken up with the distributor under whom the service station is operating. The distributor may in turn take up the matter with the company for final decision. If an adjustment is in order, it will be made through the distributor and service station to the customer.

Service stations have been granted franchises for the purpose of rendering immediate service to owners of Wright engines in their vicinity and to relieve the factory, which is primarily a production organization, of the necessity for maintaining a large service unit. Concurrent with the development of approximately 80 service stations throughout the country the factory service unit has been gradually cut down and is merely a skeleton organization and is not prepared to handle

Form No. 3000 — WRIGHT AERONAUTICAL CORPORATION — Engine No.
2/17/30 — Paterson, N. J. — Model
Page 7. — SERVICE DIVISION INSPECTION REPORT — S.D.O. No.
FINAL INSPECTION — Date

VALVES
INTAKE OPENS — EXHAUST OPENS — IGNITION

1 ____ Deg.B.T.C. ____ Deg.B.T.C. — DEGREES BEFORE TOP CENTER
2 ____ " ____ "
3 ____ " ____ "
4 ____ " ____ "
5 ____ " ____ " — TIMING INSPECTED BY

ENGINE INSPECTED BEFORE TEST BY

Intake Pipe Packing Nuts — Valve Springs
Intake Pipe Units — Rock.Box Covers for Air.Interfer.
Push Rod Housings — Rocker Arm Lubrication
Oil Strainer — Spark Plugs
Rocker Box Clearance — Spark Plug Terminals
Push Rods Lubricated — End Play in Crankshaft
Valve Clearance — Magneto Synchronization
Rocker Roller Wear — Enamel & General Appearance

PACKED BY — CARBURETOR — MAGNETO
SLUSHED — TYPE — R.H.NO.
UNSLUSHED — NO. — L.H.NO.

PACKED IN STANDARD DOMESTIC BOX
PACKED IN STANDARD EXPORT BOX
PACKED IN CRADLE
UNATTACHED PARTS
PACKED BY
PACKING INSPECTED BY

CHANGES MADE AFTER TEST

ENGINE INSPECTED AFTER TEST BY

REMARKS

Page 7 of Wright service inspection report, indicating results of final inspection of engine.

outside service work. It is maintained primarily as a research laboratory to investigate and correct unknown difficulties which may appear in actual service operations, and only enough overhaul work is taken in to keep the highly trained personnel in actual contact with unusual or extraordinary conditions. These men are rotated between actual field work and service shop work and are frequently available for transfer to the payrolls of authorized service stations or operators using Wright engines and who maintain overhaul shops of their own. In order that engine owners receive the quickest service possible at a minimum cost, it is suggested that they have the nearest authorized service station perform their maintenance and overhaul work. Each service station is required to carry a stock of genuine Wright parts and the necessary tools to perform complete service on models that are in general use, to maintain competent personnel, to contact owners in their vicinity for the purpose of offering their advice and experience in the proper maintenance of engines, to be courteous to customers and to maintain neat quarters. Failure to comply with the foregoing requisites is sufficient cause for cancellation of franchise. The service station is responsible for its own workmanship and in upholding the name of Wright in its community. Each service station is appointed by the distributor in whose territory he is located, with the approval of the manufacturer.

The distributor of engine parts must always maintain a most complete authorized service station and is fully responsible for his own workmanship and must carry a sufficient stock of parts to meet the requirements of any kind of service in his territory and he is also responsible for the appointment and guidance of service stations in his territory and is required to appoint service stations wherever sufficient business warrants. It is his duty to see that the service stations in his territory carry sufficient spare parts to complete normal overhauls of engines or that parts can be supplied soon enough to prevent any delay whatever in an overhaul. The distributor, with the approval of Wright, may cancel the contract of any service station that fails to live up to its franchise.

To augment the authorized service station a great many small or medium-sized operating lines should be well able to afford the installation of sufficient equipment to perform the major part of their complete overhauls and all of their top overhauls. The necessary overhaul stands, complete station tool kits, small drill press, small speed lathe, valve grinder, wire wheel, wash stands, parts racks, and small miscellaneous tools should be procurable at a cost of between $4,000 and $8,000. Such an investment should readily pay for itself in reduced maintenance costs.

Through the courtesy of the Curtiss-Wright Flying Service (Memphis base) a typical overhaul shop is shown in the accompanying photograph on page 95. The assembly benches are seen on the right and on the left a welding bench. At the far end of the room can be seen the stock room window which is very convenient. Just inside the stock room the tools for top overhaul are arranged on a board. On this board are arranged the tools for a top overhaul of Wright, Curtiss, and Pratt & Whitney engines.

The Wright Company maintains a school room and instructor at Paterson where at any time mechanics in the employ of owners or operators of Wright engines are welcome to receive instruction in the care and maintenance of these engines. There is no charge for this service but arrangements for enrollment are made directly between the employer and the service division.

Form No. 3000 — WRIGHT AERONAUTICAL CORPORATION — Engine No.
3/26/30 — Paterson, N. J. — Model
Page 6. — ROUTINE ENGINE INSPECTION TEST. — S.D.O.No.
Date

Test Stand No. — Carburetor Type
No. — No.
Run in Date — Jets — Chokes
Magneto Type
No. L.H. — No.R.H.
Advance
Compression Ratio
Special Equipment
Fuel Used — S.G.
Oil Used — Spark Plugs
Carburetor Flooding
Gas, Water & Oil Leaks noted
Changes and Replacements
Notes

Time	R.P.M.	Oil Temper. In	Oil Temper. Out	Oil Press.	Manifold Vacuum In. Hyg.	Carb. Air Temp.

Final Acceptance Test Date — Barometer — Weather

Time	R.P.M.	Oil Temper. In	Oil Temper. Out	Oil Press.	Manifold Vacuum In. Hyg.	Carb. Air Temp.	Fuel Sec. lbs	Oil On Scales	Oil Os Per Minute	Obser. H.P.	Corrected H.P.	Fuel Cons. lb. Hr.Hr.

Average Fuel Cons. — Average Corrected H.P.

Full Load Test — Barometer — Weather

Time	R.P.M.	Oil Temper. In	Oil Temper. Out	Oil Press.	Manifold Vacuum In. Hyg.	Carb. Air Temp.	Fuel Sec. lbs	Oil On Scales	Oil Os Per Minute	Obser. H.P.	Corrected H.P.	Fuel Cons. lb. Hr.Hr.

Average Fuel Cons. — Average Corrected H.P. — Oil Cons.Lb/Hr — Lb.H.P.Hr.
Max RR
Max RR

Idle Test — Oil Pressure — Lbs.Per Sq.In.
Acceleration Test, Idle Speed to Normal Speed — Idle Load
Opening Throttle Slowly — Compression
Jerking Throttle Open — Notes
Functioning of both Magnetos(R.P.M.Both — R.P.M.L.H.Magneto
At rated load and speed (Magnetos — R.P.M.R.H.Magneto
Notes
Total Time On Test — Inspected By
Tested By — Accepted
Rejected By
Approved By
If Rejected, Why?

The routine engine inspection test form as used by the Wright company.

THE PLACE OF PRESSURE DISTRIBUTION TESTS IN STRUCTURAL DESIGN

By Richard V. Rhode
Aeronautical Engineer
National Advisory Committee for Aeronautics

One of the most important and complete of the fundamental aerodynamic research problems of the National Advisory Committee for Aeronautics is the investigation of pressure distribution or loading for various conditions of flight. The value of the data thus obtained to the structural engineer is immediately apparent. This work has been carried to virtually all parts of an airplane and has extended over a long period of time. In the present article Mr. Rhode discusses the significance of the results arrived at to date.

A GLANCE at any of the more recent surveys of the causes of airplane accidents will disclose that structural failures have been responsible for but a small proportion of such accidents. This immediately suggests that the structural design rests upon fairly solid foundations and implies that considerable improvement must have been made, since the earlier days of the airplane, in our knowledge of the external loads coming into play on aircraft structures and of the properties of the materials used therein. This is true, but although these great advances have been made, and although structural integrity is only one of many elements which go to make up an acceptable airplane, further improvement is not only desirable but necessary if weight is to be reduced to a minimum and confidence in the airplane is to become deep-rooted. How, then, are such improvements to be effected?

To begin with, the factors upon which the structural integrity depends must be examined. Basic, of course, is the proper determination of the loading conditions which may be critical for the various sub-assemblies of the structure. In so far as the flight loads are concerned, this involves first of all a knowledge of the probable attitudes of the airplane with respect to the air and the ground and the probable speeds at these attitudes. From this knowledge the total loads can be determined. After this, the manner in which the total loads are distributed over the structure must be known. With these two factors soundly established, the procurement of structural integrity devolves upon the strength and reliability of the materials of construction and the accuracy of the methods of stress analysis. While the importance of these last cannot be minimized, we will put them aside for the purpose of this article and consider only the second factor, viz., the determination of the manner in which the total load is distributed over the airplane.

In a large majority of cases, the designer does not concern himself with a detailed study of the pressure distribution, but accepts the specified load distribution found in the handbook. Usually he accepts this distribution without question, but at times with a sincere conviction that the handbook is wrong, especially when the satisfaction of a given ruling requires one or more unusually heavy members in the design. In such cases there is little recourse for the designer, since existing data are insufficient to justify a change in a rule which is frankly intended to be conservative. A good illustration of a rule of this kind is the one concerning tip loss, and more particularly the clause which requires 30 per cent to be added to the spar bending moments from the outer point of inflection in the outer bay to the tip. The best that can be said for the specifications in such cases is that they are not too far wrong. After all, the rules have been based in large part on the results of a few pressure distribution tests and ordinary force tests, some of which have been made in flight and most of which have been made in the wind tunnel. However, since these few tests, in the main, have been restricted in scope, they give but a general qualitative and rough quantitative picture of many of the important phenomena in which the designer should be interested. At present there is at hand no general solution of this difficulty, since no comprehensive analysis of the rather

loosely-connected available information has been completed. Too, information is still lacking on many important questions.

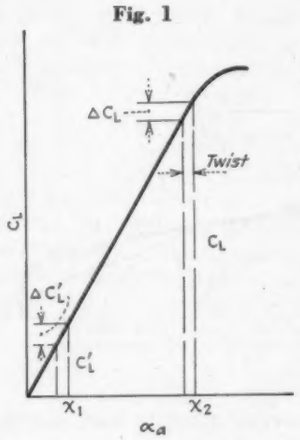
The above is not intended to imply that progress is at a standstill. Studies of a number of phases of the problem of external loads are being made and elaborate tests are being conducted to extend our knowledge of these loads. Let us examine a few of the prenomena disclosed by some recent experiments of this kind and learn the nature of the information obtained. The tests conducted by the National Advisory Committee for Aeronautics on the PW-9 (Rhode, R. V., "The Pressure Distribution over the Wings and Tail Surfaces of the PW-9 Pursuit Airplane in Flight," N.A.C.A. Technical Report) pursuit airplane provide good examples.

THE object of the PW-9 tests was rather general and included the determination of the time-correlation of the inertia and aerodynamic loads as well as the magnitude and distribution of the aerodynamic loads on the wing cellule and tail surfaces. Since the PW-9 airplane, like most airplanes, is quite individual and differs from its contemporaries in wing cellule arrangement, wing plan form, tail characteristics, etc., pressure distribution tests on this airplane are not well adapted for use in a systematic study of the effects of changes in the shape and arrangement of aerodynamic surfaces. They are, however, distinctly useful in pointing out the more serious discrepancies between the present specified load distributions and those actually experienced. In addition, they give a good general picture of the phenomena associated with the maneuvers to which acrobatic airplanes may be subjected.

An interesting example of a factor having an important bearing on the distribution of load as disclosed by the PW-9 tests is the possibility of a twist in the wing. An examination of the data taken in a number of steady flight runs throughout a wide range of angle of attack brought to light that as the lower angles were approached, the distribution of load along the span of the upper wing tapered off rapidly toward the tip and the position of the center of pressure moved progressively farther back along the chord as the tip was approached. This was contrary to expectations, since wind-tunnel tests had indicated a general similarity of load curves at all angles of attack and practically the same position of the center of pressure in per cent of chord at each station along the span for any given angle. This discrepancy gave rise to the suspicion that the wing was somewhat twisted and that this twist had a large effect on the load distribution at low angles of attack. Such a twist may be rigged or built into the structure or it may be caused by a torsional deflection under load. With respect to this latter point, the elastic axis of the wing is usually in the neighborhood of 30 per cent of the chord. It is evident, then, that if the resultant load on the wing acts to the rear of this axis a torsional deflection will result. At high angles of attack, with the center of pressure forward, little deflection would be expected in any case, although at low angles with the center of pressure well back, a large or small deflection may result, depending on whether the total load is large or small. Finally, since the root of the wing is more rigid with respect to the fuselage than the outer portion, this deflection takes on the aspect of twist with the tip at the lesser incidence.

It is fairly obvious, from a consideration of Fig. 1, that a twist at the higher angles of attack does not affect the lift distribution along the span appreciably, while at the lower angles a large proportional variation results. If we assume, for purposes of illustration, that the lift distribution along the span for the untwisted wing is rectangular and that the load at any section is proportional to the angle of attack of that section, then the reduction in load at the tip, when α_a is, say, x_2^0 at the root section, is $\Delta C_L/C_L$, a small value. On the other hand, the reduction of load at the tip at a low angle such as x_1^0 is $\Delta C_L^1/C_L^1$ a relatively large value. At the lower angles, too, the center of pressure varies rapidly with the angle of attack so that not only is the load distribution along the span affected, but also that along the chord.

Fig. 1



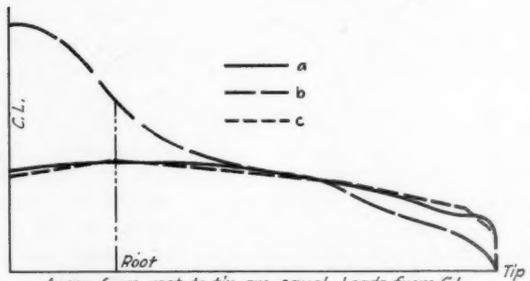
Actually, the determination of the true effect of twist is rather more involved than the above illustration would indicate, although the results are qualitatively the same.

In Fig. 2 is shown the effect of 3 deg. washout on the PW-9 upper wing at the angle of attack corresponding to level flight at maximum speed. Curve "a" is representative of the distribution of load at a high angle of attack in which the effect of twist is negligible. Curve "b" is the measured distribution at an angle of attack of the root section of 4.5° (absolute), corresponding to

The PW-9 airplane, on which extensive pressure distribution tests have been made in actual flight by the National Advisory Committee for Aeronautics.

maximum speed, and curve "c" the load distribution determined from the rules. It is at once apparent that in the low angle of attack design condition there is a considerable difference between the assumed span load distribution and that actually obtained in flight on this airplane. While this difference may be a conservative or non-conservative factor, depending upon the influence of other variables in the load distribution and the type of structure employed, it is evident that the twist, whether a built or rigged-in feature of the wing or a torsional deflection under load, must be a matter for

Fig. 2



consideration if we desire an accurate load distribution as the basis for design.

If a slight diversion from the purpose of this paper be permitted, another interesting way in which deflections of the structure alter aerodynamic loads was disclosed by a comparison of calculated and measured tail loads on the F6C-4 airplane. Calculations indicated that the load on the horizontal tail surfaces of this airplane in a dive at 247 m.p.h. should be 920 lb. Measurements in such a dive indicated a load of 468 lb. A close scrutiny of the calculations as to basic data, method, and arithmetic gave no reason to believe that the results should not have been very nearly correct. Likewise, a careful examination of the pressure distribution data gave no reason to believe that these results, also, were not substantially correct. Why, then, the discrepancy? Without going into detail, it may be stated that the principal factor influencing the tail load in a steep dive is the moment coefficient of the wing. In fact, at a given speed in a dive, the tail load is almost directly proportional to the wing moment coefficient, all other factors being quite secondary for conventional airplanes. Since this is true, it was reasonable to conclude that there was a large difference between the value of the moment coefficient used in the calculations and that existing during the test dives. But the value used in the calculations was soundly established by wind-tunnel tests at low and high Reynolds' numbers as well as by flight tests. It was, therefore, further concluded that the wing moment coefficient of the F6C-4 wing cellule was reduced by virtue of a deflection of the ribs and ailerons under the conditions of load encountered in the dive.

While the above conclusion has not been proved in the accepted sense of the term, it can easily be defended as plausible by a consideration of Figs. 3 and 4. In Fig. 3 it is seen that the difference between the M-6 and the Clark Y airfoils is negligible except aft of the rear spar and that the difference in moment coefficient is great, C_m being almost zero for the former airfoil and —0.07 for the latter (which, incidentally, is used on

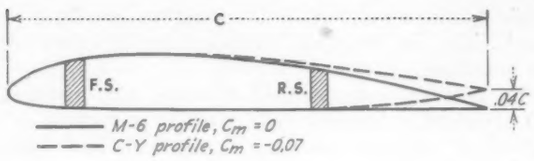


Fig. 3

the F6C-4). It is reasonable to expect that under the conditions of rib loading shown in Fig. 4, which is typical near zero lift, there would result a distortion of the Clark Y airfoil toward the M-6 form with a corresponding reduction in C_m and hence tail load. That such deflections may be appreciable is attested by the fact that trailing edge failures are known to have occurred in fast dives on some airplanes.

To return to our main subject, it has already been noted in Fig. 2 that the load curve measured at a high angle of attack is in good agreement with the assumed load curve for the PW-9 upper wing. This is also true of the lower wing. Two effects enter in, however, which tend to bring the calculated and actual stresses into disagreement. One of these is a difference between the center of pressure position assumed in the design (determined from monoplane tests in the wind tunnel) and the position measured on the biplane upper wing in flight. Fig. 5 shows the outline of the PW-9 upper wing with the center of pressure locus as measured at maximum

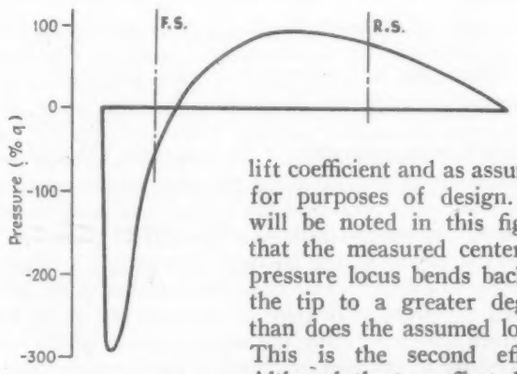


Fig. 4

lift coefficient and as assumed for purposes of design. It will be noted in this figure that the measured center of pressure locus bends back at the tip to a greater degree than does the assumed locus. This is the second effect. Although the two effects both have to do with the center of pressure position, it is well to consider them separately since the first is essentially a phenomenon caused by the superposition of two airfoils, or biplane arrangement, while the second is caused by tip shape. The result of these two effects on the PW-9 airplane is to produce a front spar load curve which differs from the design load curve as shown in Fig. 6. As a simple illustration of the importance of such a difference in spar loads, a primary bending moment diagram is given in Fig. 7 which speaks for itself.

The effect of the biplane arrangement in moving the upper wing center of pressure forward of the monoplane position is a fairly well-known phenomenon and has been shown a number of times by wind-tunnel tests on biplane cellules. It was, therefore, predictable and hence could have been and can be taken into account on the basis of information which has been available for some time. The influence of the tip shape, however,

still remains uncertain in new designs. In the present case the tip loss specified, although intended to be conservative, was not sufficient to allow for a rearward displacement of the center of pressure from the assumed value. From this, the importance of further knowledge regarding wing-tip pressure distribution is apparent and

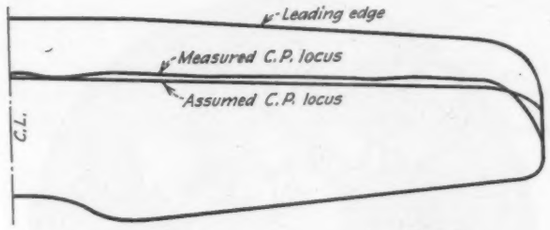
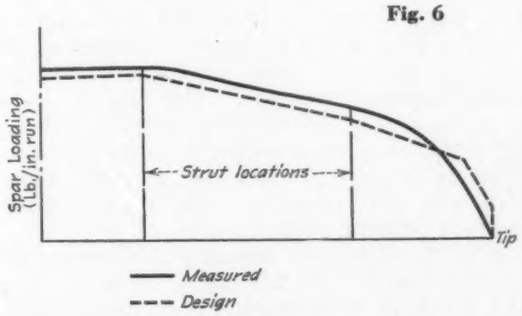


Fig. 5

a distinct value attaches to the results of any tests which throw light on the subject.

ANOTHER interesting result of the PW-9 tests which has an important bearing on the structural design is the evidence of abnormally high normal force coefficients on the upper wing in maneuvers involving angular velocity in pitch. It was found that the average maximum value of the upper wing coefficient of normal force for such maneuvers was 1.66 whereas the value for the wind-tunnel model, corrected to full-scale, was only 1.43. This discrepancy is believed to be caused by the time element in eddy formations. Since time is required for the back-flow in the boundary layer to reach the stage where the first vortex can be formed, the streamline flow around a pitching airfoil does not instantly break down when the normal or steady flight angle of attack is reached, but it continues in force for a short time while the wing rotates beyond this angle with the result that the lift continues to build up to an abnormal value. With respect to the lower wing, when the maximum total load on the cellule is reached, the above discussion

Fig. 6



does not apply since the burble on the lower wing has been delayed as result of the presence of the upper wing. Also, on the lower wing, the "C_L vs. α" curve has been flattened out somewhat at the higher angles because of the upper wing influence. Therefore, the increment of lift on the lower wing corresponding to the "abnormal" increment on the upper wing due to pitching, is relatively small and the consequence is a higher relative wing load ratio $\frac{C_L \text{ upper}}{C_L \text{ lower}}$ than the wind-tunnel results would lead one to believe was correct at peak load. On the PW-9 the increase due, presumably, to the cause above discussed, was about 16 per cent.

The above explanation of the cause of the high normal force coefficients is by no means, of course, conclusive. Indeed, further confirmation of the high values of upper wing C_N should be obtained in other tests before too much weight can be attached to the PW-9 results in this matter. On the other hand, the difference between the flight and wind tunnel relative wing load ratio at peak load is marked, and other evidences of the validity of the explanation given have been found. It is a field for further study.

One more point which should be mentioned is the existence of very great downward acting pressures on the leading edges of cambered airfoils in fast flight near zero lift, that is, in nose dives. The present rules concerning leading edge leads are based on flight measurements on the VE-7 and T-S airplanes and give good results for the high angle of attack condition to which they were evidently intended to apply more particularly. The more or less arbitrary assumption that this specified load may also act in the opposite direction is correct in sense but misleading in degree, and may prove dangerous in the case of airplanes whose service maneuvers include

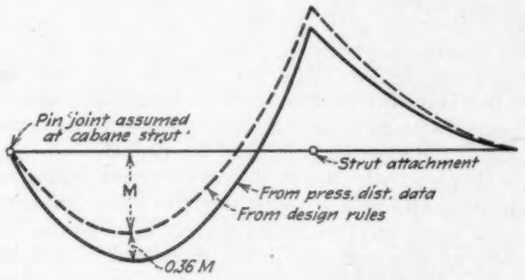


Fig. 7

fast, steep dives. At least one case is known where a leading-edge failure in a dive resulted in the disintegration of a considerable portion of the wing structure, a complete loss of the ship being avoided only by the calm judgment and skillful handling on the part of the pilot. Such accidents and their causes are not common knowledge and the lesson is learned by only a few. The results obtained in the PW-9 tests, in which downward acting pressures of nearly 500 lb. per sq.ft. were measured in dives, cannot fail to attract attention to the severity of these leading edge loads. Although the subject is too extensive to treat here, it may be said as a suggestion, that pressure distribution diagrams at or near zero lift should be studied intelligently when designing an airplane intended to dive at high speed.

IT IS hoped that the above discussion of a few important questions relating to load distribution has served to illustrate the importance of pressure distribution tests and their place in design. Analyses are under way which should go a long way toward removing uncertainties in establishing the proper design loads and the mysterious aspects of some recent airplane accidents. In the meantime, it is the opinion of the writer that until the differences between the assumed loads and load distributions and those actually encountered become nil, the use of the refined and more precise methods of stress analysis is unjustified except where such use results in more conservative design.

AVIATION CLUBS IN THE COLLEGES

By John C. Holme

Students of the New York University ground school working at engine overhauling

The evil repute which surrounds the "collegiate Ford" has perhaps made aircraft manufacturers shy of seeking in the colleges a market for a craft in which dilapidation threatens disaster. But there is a gradual accumulation of collegiate fiying experience to show that a student organization can be fully aware of the importance of keeping flying equipment in proper condition and of operating it under proper restrictions. Students are flying, safely and regularly, and the airplane salesman must give them due attention. Mr. Holme, lately the president of the Dartmouth Aero Club, explains the nature of the colleges' activities and some ways they have progressed towards financial stability.

COLLEGIATE interest in aviation, at present demonstrated at 34 colleges in the form of engineering study, ground school courses, and flying and gliding clubs, is by no means a novelty. There were eighteen college clubs in 1910, resembling each other in their sporting interest in flying, and technical interest in experimental designing. Typical was the Aeronautical Society of the University of Pennsylvania, where 100 members, mostly engineers, promoted balloon meets or met to discuss aircraft design. The Harvard Flying Club sponsored the Harvard-Boston Meet at Squantum, Mass., in 1910, one of the first airplane meets held in this country, and one of the most successful of the period.

The characteristic club of that early period was a group of students who as a campus novelty, were enthusiastic about the sport and theoretical aspects of aviation. Practical activity was centered in ten clubs which built body-control, or "hang" gliders and power machines of their own design, and attended an intercollegiate glider meet near Boston in 1911. This original formation of college aviation clubs was short-lived. Like many another collegiate activity it failed to survive the graduation of charter members.

The next incarnation of the clubs came in 1919, when war-trained pilots returned to finish their college courses. Flying activities were dependent on the use of military equipment, the members holding their Reserve commissions. After the graduation of the members who had learned to fly in the War, most of the clubs again fell apart.

The formation of aviation clubs at twenty colleges in the past three years brings the movement up to date, in its third period. Clubs of 1910 and 1919 origin were first to reorganize in this recent wave of interest, which differs from previous college aeronautics in having a reasonable expectancy of life. The type of activities found at these clubs are technical, military, flying, and gliding, and most of them develop from theoretical study to actual flight training. Reaching the final stages of adequate and self-supporting flying organizations has become their principal problem.

Many of the clubs have started with a ground school course as a step toward introducing members to engineering, flying, or management. Such courses were inserted in the engineering curriculum or given by members whose previous flight work and engineering studies fitted them to instruct fellow members.

A number of universities now includes Air Corps Units in their Reserve Officers' Training Corps. In the spring of 1929 over 1,700 students were active in such units, but an average of less than three of the military group in every college finally qualified as military pilots.

Although there were over 3,000 men in 39 colleges active in flying, gliding, ground schools or R.O.T.C. organizations during the last school year, actually less than 10 per cent of them received flight instruction. Lacking the financial organization to take powered flight

The OX-5 Waco used by the Yale Aeronautical Society

instruction, gliding clubs were organized at Butler, M.I.T., Michigan, and Kansas with an average membership of 100 students. Plans made for the design and construction of club gliders by the engineering students were successful at the two older established clubs affiliated with schools having good engineering courses, M.I.T. and Michigan. In the 29 clubs devoted to flying in 1928-1929, taken as a whole, the interest in gliding remained small.

THE purely theoretical nature of the work of the majority of students is evidenced by the fact that only nine clubs had equipment to work with in their ground schools. Only a few of these clubs availed themselves of the opportunity of getting training in rigging, fuselage construction and engine repairs, presented by the generosity of the Army and Navy in lending obsolete and damaged planes and engines to the schools for instruction purposes. Other clubs salvaged crack-ups, or acquired worn out engines as material for their practical work.

In the school year of 1928-1929, actual flying was done by students in club-owned planes at only five colleges, and by other students in their personally owned planes at twenty other colleges. The remaining flying members, and non-member pilots, did their flying at nearby airports where time at $15 to $20 per solo hour restricted the number of pilots to those students who could afford it. Where a plane has been owned by a club, the hourly rate has commonly been kept at $10 or less.

A comparison of the activities of the school year 1928-1929 with the school year 1929-1930 shows a remarkable increase in practical activity and improvement in organization. A year ago, students in 43 colleges were busy organizing aviation clubs. Aeronautical Societies and flying clubs were established in colleges where there had been ground schools or gliding activity in previous years, as well as in institutions where interest in aviation had never definitely been shown. By the spring of 1930, 34 of these 43 clubs were successful in promoting some definite activity, with over 2,000 undergraduates actually flying, gliding, or preparing for flight instruction in their ground school activities.

There were 169 pilots who flew regularly during the school year 1929-1930 in the nine most active flying clubs, located at Carnegie, Detroit, Harvard, Kansas, M.I.T., Michigan, N.Y.U., Ohio State, and Yale. Most of these members got their dual and first solo time at commercial airports on rented planes, Harvard being the only club to train its members on a club-owned ship. Eleven different makes were rented, the most popular being Waco, Fledgling and Fleet. Besides these club pilots, there were 78 non-member pilots, whose interest in private flying was so purely individual that they did not affiliate with a flying club at their college.

The college year 1929-1930 thus showed an increase in the number of college pilots from 208 to 250. While the majority of this number did not belong to flying clubs in 1929, more than two-thirds of all college pilots were full-fledged club members during the past college year. Students have found that in a college flying club, they can get more hours aloft, more economically. Many clubs have found in the past year that a saving can be effected by having their own ground schools, aided by professors of physics and other engineering courses in these colleges. The administrative officials of some colleges have been quick to recognize this demand, and offer courses patterned after military ground schools in the regular curriculum.

The advantages of organization are nowhere better seen than in the fact that, during the last college year, 146 undergraduate pilots logged a total of more than 3,700 hr. aloft in the seven flying clubs at Detroit, Harvard, Kansas, Michigan, N.Y.U., Ohio and Yale.

AS AN example of the type of club all college flying organizations are working toward, the Harvard Flying Club has become classic. The only club to own its own planes over a three-year period, it has effectively demonstrated during this time that club-ownership of a plane can give the members solo time at about $11 per hour, or approximately half of the usual hourly solo charge. During this three-year period the members of the Harvard club have had over 1,150 hr. aloft in club-owned ships. Their safety record of over 1,000 hr. flying with only one forced landing and without damage to equipment or personnel might well be advertised by the members of an industry whose business it is to claim and advertise the safety of flying operations. Harvard's record of hours and safety are due largely to its system

President Ken Aldrich of the University of Michigan Glider Club in the club's repair shop

of having pilot members act in rotation as field manager, responsible for the day for the airworthy condition of the plane and the adherence of members to strict but reasonable rules. This is but one of many assignments each member covers, giving each experience in the general management of a flying organization. The Harvard planes are traded in every year for new models at very reasonable terms through the assistance of one of their charter members, now manager of a sales and service agency at the local airport.

Other clubs are working on the same principle of co-operation and collective bargaining that has made the Harvard club the owner of its planes, the most successful of American college flying groups, and the first winner of the Loening Trophy for intercollegiate aviation. Twenty clubs are now rapidly developing in the preliminary stages of ground schooling through which the Harvard club has successfully passed, working toward the time when they will be flying their own ships.

Gliding clubs were functioning during the past year at eight colleges—Dartmouth, Detroit, Kansas, M.I.T., Michigan, Ohio, Richmond and Yale. Nearly 300 members were active. M.I.T. and Michigan again succeeded in building and flying their own gliders, as they had done before; M.I.T. intermittently since 1909, Michigan since 1916. The clubs are built around a nucleus of student engineers who build their own gliders or buy them and then gain practical experience by flying, repairing, and re-designing them.

The University of Michigan's glider section of 129 members, is one of the largest groups learning to glide in this country. These members are instructed one hour per week in both flying and repairing. Fourteen student instructors act as operations managers in the two activities using one secondary and three primary gliders.

OF THE various interests seeking to promote college aviation clubs similar to other associations in the industry, the Inter-Collegiate Aeronautic Association has done the best work over a period of time. Sponsored by the Yale Aeronautical Society in the spring of 1928, its first meeting was attended by delegates from eleven colleges. Its second and third conferences held in the spring of 1929 at the Detroit Aircraft Manufacturers Show, and in the fall of 1929 at Ohio State University, drew delegates from thirteen and twenty colleges respectively. Carried along by the same interest that drew Eastern Colleges together for the initial convention in 1909 at the University of Pennsylvania, the I.C.A.A. has sought to promote interest in flying light training planes as a college sport. Actually, these conventions aided clubs in solving their difficulties about plane rental and ownership, regulation of college competition, and faculty approval of the flying clubs. Their success in the latter may be measured by the fact that only Princeton, Yale and Amherst, Carnegie and Illinois will not permit club flying.

The outstanding influence among college aviation clubs has been the Loening Inter-Collegiate Air Contest, which seeks to increase college flying for the benefit of civil aviation and a military reserve. The announcement of this contest increased collegiate rivalry to an extent practically unknown since the undergraduate days of its sponsor, Grover C. Loening. He was vice-president of the Columbia University Aero Club in 1909 when it sponsored one of the many glider meets held during the early period in collegiate aeronautics.

The awarding of $2,500 in prizes in May, 1930, climaxed activities of the college flying clubs for the year 1929-1930. The contest was won by the Harvard Flying Club (the only club to own its plane) with a total of 468 hr. flown by 22 pilots in their 165 hp. Whirlwind Travel Air. The award of the trophy and $1,000 in cash has enabled this club to add to its equipment.

In comparison with Harvard's record, the University of Detroit Aeronautical Society's 39 pilots flew 1,703 hr. in the contest period, winning second prize of $500. This demonstrated that the contest was not judged merely on hours aloft flown under club auspices, for a large part of Detroit's time was accumulated by part-time engineering students who fly as military reserve officers or as commercial pilots when not in school. Additional credit was given in recognition of the Detroit Society's glider section comprising 100 students, one-third of whom averaged over three flights each per week. About 100 flights per week are in gliders of their own design and construction. Eighteen Yale pilots flew 361 hr. In view of administrative opposition to operating a club-owned plane, this society was favored for third prize of $300 over the New York University Flying Club, winner of third prize of $200 though N. Y. U.'s record was barely eclipsed by Yale.

SIGNIFICANCE to aircraft manufacturers of college flying as a part of private flying is indicated by student purchases. In 1928-1929, students at 28 colleges owned and flew over 9 per cent of the total number of planes—estimated at 841—sold during this period as private and pleasure aircraft. At this time, the average cost of a student-owned plane was $4,600. These include thirteen Waco; eight Travel Airs; five Eaglerocks; and two Ryan monoplanes, according to a survey conducted by the Collegiate Special Advertising Agency, Inc., of New York.

The contribution of college clubs to the private flying movement is in 300 pilots who flew 6,000 hr. during the school year 1929-1930, according to an approximation drawn from a survey of college flying clubs during the six months ending June 30.

The value of training college men in flying is recognized by the English and Canadian governments in subsidizing military flying units at Universities of McGill and Montreal; Hull and Oxford. The late Lord Thompson when Air Minister of England, had a three-fold interest in aiding undergraduate flying clubs with equipment and trained personnel: the stimulation of private flying, the fostering of aeronautical research, and the encouragement of college men to make the Royal Air Force their profession. College men in this country, however, have been unable to secure active government appreciation of these facts, save the recent stipulation that all applicants for Army and Navy, and Marine flight training must have a Bachelor's degree.

One of the major contributions of colleges to the entire industry is in training engineers and executives. College trained men now form a representative group of leaders in the engineering and business field of many older industries. Since 26 colleges provide some instruction in technical aeronautics (seven being engineering courses sponsored by the Guggenheim Foundation), and most universities have courses in business procedure, advertising, accounting, and other subjects leading to management, college men may reasonably be expected to form a good part of the back-bone of leadership in the aviation industry of the near future.

THE INTERIOR DECORATOR HAS HIS DAY

By John F. Hardecker
Naval Aircraft Factory, Philadelphia, Pa.

A discussion of the characteristics and effects produced by the various available finishing and insulating materials for the interiors of aircraft

WITH the modern high development of mechanical design in aircraft—greater emphasis must now be placed on color, beauty, styling. No longer can the aircraft manufacturer depend exclusively on mechanical superiority for competitive sales success. It is time to turn attention to furnishings and appointments—factors which play no small part in popularizing airplane transportation. The stylist should have his day with the interior decoration of aircraft.

The same simplicity and grace characterizes the exterior of a plane should be sought in the interior. The cabin should be a delightful place in which to ride—comfortable, restful and substantial in appearance. Appointments should not imitate other interiors but rather portray the buoyancy and spirit of this modern mode of travel.

Achievements of pleasing decorative effects, however, must not be divorced from utilitarian requirements—this applies as much to upholstery and interior furnishings as it does to streamlines and exterior finishes. Materials which combine atmospheric delicacy with practical wearing qualities, would appear to be the perfect types for the interior of the airplane body.

In these days when psychological reactions have been brought into the practical realm of business, and manufacturers are looking more and more toward artistic fitness as well as utilitarian applications, it pays to study types of materials, colors and designs, that harmonize with air travel—fabrics and colors which interpret, in appearance, the style "feeling" and psychological reaction of the passenger.

The element in which the airplane travels is the highest human conception of lightness, immateriality and color—atmosphere, of course, being the medium for color-light. Because the plant is moving in a maximum of light much of the time, it is essential that the tones, colors and surfaces are such as will reflect perfectly and richly the play of sunlight, and the strong reflected light of water.

The "metallic" finishes which are so popular for exteriors are finding ready acceptance for upholstery fabrics for aircraft, partly because they react well to reflected light and color effect, partly because they conserve the idea of a unit of color and design, and in addition, because they tend to lend an appearance of reliability and strength. For this reason silver plays a large part in aerial color schemes and silver effect fabrics are popular.

The foregoing should not be taken as indicative of a universal trend—individuality is still rampant, and fortunately so. Proper interior decoration provides a full

Sikorsky Amphibion interior employing Schumacher modernistic rayon fabrics

opportunity for intelligent originality. In planes for private owners, beauty and convenience attain the same importance that they hold in motor car design. In fact, the custom decorated plane is beginning to become a significant factor in private plane sales.

Much has often been said of the contrast in appearance by the foreign traveller who compared our transport planes with those operating in Europe. Such contrast has usually been decidedly unfavorable to our planes, the feeling being that the European manufacturer lays considerable stress upon interior appearance, while in this country the interior of the plane is handled by mechanics and is merely considered in a mechanical way. That foreign interiors are decidedly attractive is very true, but attention is respectfully called to the fact that our own progress in this field within the last year has been truly remarkable.

Most of the progress made may be distinctly traced to the advent of the professional decorator in the aircraft field. It is to the everlasting credit of our plane manufacturers that wherever they have been able to find specialists in any field who were willing and competent to aid in the solutions of a specific problem, they have unhesitatingly enlisted their co-operation. This matter of interior decorating is a decidedly professional matter, and the progressive plane manufacturer is rapidly becoming conscious of this fact.

While the matter of interior decoration may be satisfactorily entrusted entirely in the competent hands of the professional decorator, it is believed that the airplane manufacturer should have at least a general knowledge of the types of material available. This need not be detailed, expert knowledge, but it should at least be sufficiently comprehensive so that he may discuss intelligently his problems and desires in the terms and language of the decorator he employs. For that reason, certain basic information and background centering about these materials will now be included. The information will naturally be restricted both as to detail and scope, but its value for the purpose outlined should not be impaired thereby.

Top: Curtiss Robin interior. Lower walls and seat, maroon moire; upper walls and ceiling, beige antique cloth; trimming, red galoon.

Above: Travel Air business plane upholstered in Chase Velmo mohair velvet.

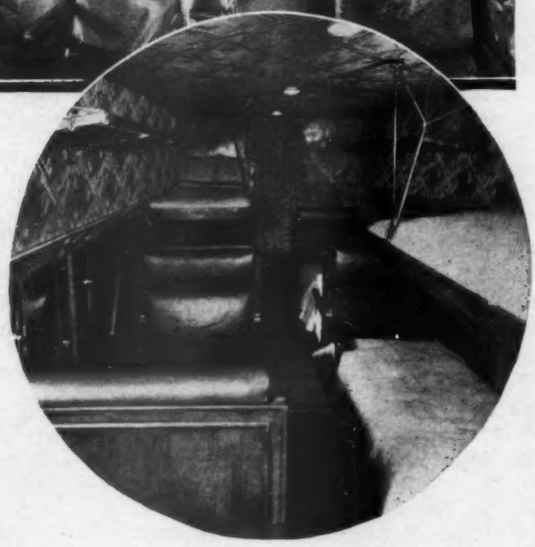
Right: Interior of Consolidated Commodore using green frieze for the seats, green fabrikoid for the lower portion of seats, and special air brushed fabrikoid for the walls.

MOHAIR pile fabric, or mohair velvets, lend themselves to all kinds of interesting and rich effects both in color and design. Because of the peculiar adaptability of mohair velvet to take rich dyes, it adequately meets the demand for absorbing and holding colors that are both sun-proof and weather-proof. The luxurious close pile of a good mohair plush combines delicacy of "feeling" with substantiality. The soft yielding comfort associated with the snug, clinging character

Left: A custom decorated Bach plane having grey green cabin walls, modernistic silver leaf ceiling, molding in satin silver, and ceiling panels with modernistic designs in corners and center.

Below: Interior of a Western Air Express Fokker F-32 cabin No. 3 (smoking). The ceiling is grey moire fabrikoid with black moldings; side walls modernistic brocade in henna, black and silver tobacco leaf designs; seats grey alligator skin fabrikoid; and carpets jade green.

Circle: Keystone Patrician equipped for night flying. Wall fabrics are beige and henna damask and upholstery blue fabrikoid.



of velvet pile, preventing slipping and sliding with the movement of the plane, makes it an ideal fabric.

Its claim to durability without showing evidence of wear might have had little appeal to the aircraft manufacturer ten years ago, because the life of a plane then was all too short. Today conditions have radically changed and there is a prospect of many years of useful service for the modern plane. For this reason upholstery is now being selected for its wearing qualities as well as for decoration, comfort and general suitability.

As a sanitary seat-covering, mohair velvet is highly acceptable, since its porous nature allows free circulation of air and does not hold dust and dirt on the surface. It is easily and properly cleaned merely by the application of soap and water, and such cleansing in no way destroys or injures the rich lustre of the velvet.

NEMOURSA airplane fabrics are new type light weight Fabrikoids developed especially for the interior trim of cabin planes. They are made on a high grade, woven fabric base, treated with appropriate pyroxylin colors and embossed in distinctive patterns. Pleasing colors are thus combined with practical utility, giving a material that is water-proof, cleanable, scuff-proof and light in weight. Unaffected by changing temperatures, these fabrics are proving ideal for the purpose.

These materials are extensively used for interior trim, such as side walls and head linings, seats and chairs. They are made in various weights and grades to suit specific purposes and style requirements. In general, side walls and ceilings use a drill construction cloth with pyroxylin coating, or a light sateen construction. For the portion below the medium line, where the material is submitted to much harder use, heavier sateen is generally used, and for the upholstering of chairs, seats, etc., heavy sateen or moleskin weave find favor.

Imitation leathers are usually manufactured in 50 in. widths regardless of the type of cotton cloth. The drills are the least expensive and more easily stretched, and at the same time, on account of the heavy rib of the weave, do not present as good an appearance as the sateens or moleskins. The sateens are closely woven fabrics of considerable strength and durability. The moleskins are slightly more loosely woven than the sateens, but have heavier thread and are usually napped on the back. The moleskins are favored for upholstering purposes and for other work where a more or less cushion effect is desired, for instance, as the side walls of a plane, provided they were to have padding beneath the Fabrikoid. These Fabrikoids are usually identified by a serial number, those labelled in the 3,000 series being drills, 4,000 and 6,000 series sateens and 7,000 series moleskins.

The object in Fabrikoid material designs has been to present effects that are not necessarily an imitation of leather, but that are pleasing from the standpoint of color combinations and general grain designing and at the same time, create to a greater or less extent the feeling of buoyancy, or in other terms, an aeronautic atmosphere. That this has been attained, is attested by the growing application of these materials in cabin interiors.

GENUINE leather, although one of the oldest materials known to mankind, is just beginning to come into its own in the interior decoration of planes. It is difficult to find logical reasons for its lack of application in the past, although this may have been in part at least due to the apathy of the leather industry itself.

The best upholstery leathers are made from hides known as Packers. By the time these hides go through the various processes of soaking, fleshing, toggling, dehairing, beaming, bating, tanning, splitting, etc., ten weeks have elapsed. After that comes the finer processes of coloring, which provide the attractive appearance so desirable in luxurious interiors.

Leather presents an attractive appearance when first installed and an equally attractive appearance after a year's continuous use. Airport dust, grease, or dirt of any description, can be instantly removed from leather by simply washing with any mild soap and water. This can be done once a day if desired and still the leather will outlast the plane. It is practically non-inflammable, an item worth considering in the light of cigarette smoking by passengers.

Although there is a prevailing impression to the contrary, leather is no heavier on the average than corresponding cloths and imitation leathers. Upholstery leather is made by splitting the hide, otherwise it would be too thick for use. The best is the top grain cut. These upholstery leathers are about $\frac{1}{32}$ in. thick and weigh approximately 0.111 lb. per sq.ft. They come in whole hides which average 45 to 50 sq.ft. each. There is also an extremely thin leather, known as Buffing, which is suitable for interior trim. This is sometimes glued to the cabin walls to improve the interior appearance of the plane.

OF THE many other fabric materials successfully used for interiors, space limitations do not permit a detailed description. There is damask, with its flowered or variegated patterns of the same color or different shades of the same color; moire with its watered silk finish, rep with its corded surface, brocade with its woven raised figures, frieze with its coarse weave and shaggy nap and galloon with its embroidered figures used for trimming.

Many cabins use veneers or plywoods for walls or ceiling beautifully finished in natural wood finishes, or treated with the many modern finish coatings available for the purpose. In others, plymetal, with its finish surface of aluminum or duralumin, cored with light woods such as balsa, is used effectively. In fact, in no other phase of plane design, is there greater opportunity for the play of individuality and good taste.

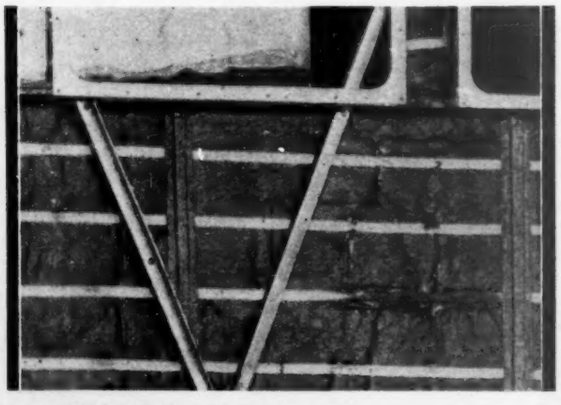
IT HAS often been said that no structure is stronger than its foundation. Similarly, it may be said that no interior, no matter how attractive to the eye, renders the maximum of cabin comfort to the passenger unless it is insulated against noise and cold. Throbbing, roaring engines may speak eloquently of power, yet unless the roar is absorbed and quieted, it is decidedly unpleasant for the passengers. In addition, it must be realized that the engine exhaust accounts for only a minority of the objectionable noises entering the ordinary cabin. It is believed that from 60 per cent to as high as 75 per cent of total noise is caused by wing roar, propeller slap, strut whine, and other similar air noises. Consequently, muffling the engine would not help to any large extent.

Proper insulation also provides a cabin which is comfortably warm in severe weather or at high altitudes. Conversation is made possible in normal tones, without interference from noise or cold. These same insulating materials are also fire safe, and surprisingly low in weight. In fact, no well designed plane, with a thought to maximum passenger attractiveness, should neglect the use of these unseen adjuncts to passenger appeal. Two of the leading insulating materials will therefore be described in some detail, so that the airplane manufacturer may better realize their possibilities.

DRY ZERO is a batt of ceiba fiber enclosed in light muslin, stitched at intervals of about 9 in. This batt is quite unique. The intensely fine and permanent resilient tubular fibers of ceibre are "grained," i.e., laid substantially parallel and across the line of sound transmission or heat flow. The efficiency of the material is thereby increased very greatly, as has been shown in tests. The batt is a semi-felt in this condition.

It should be borne in mind that to render a high degree of quiet comfort in the cabin of an airplane, it is necessary to provide deadening that will perform two functions:—reduction of sound penetration and absorption of what sound does penetrate. It is true that, generally speaking, mass is the most useful obstruction to sound penetration, but it has been found that by dampening the outside shell of the cabin by the close contact thereto of Dry-Zero Aeroplane Blanket, more obstruction is offered to sound penetration than would be expected from this very light material. In regard to the other function, this material has one of the highest average coefficients of sound absorption of any material.

Dry-Zero in addition to its high sound absorption and dampening values, is a very efficient commercial heat insulant, (thermal conductivity equals .24 B.t.u. per 1 in. thickness, per sq.ft., per deg. F. per hr.), having a conductivity such that its resistance to heat flow is 25 per



Application of Balsam-Wool to the structure of the Sikorsky S-38.

cent greater than that of cork board. Therefore, it is an excellent insulation against extreme external temperatures. Another important point is that this material has very low hygroscopic characteristics. Tests have shown that it absorbs only about 49 per cent as much moisture from humid air as cork, which in itself is unique. This is important in a plane in view of the frequent moisture conditions of the air.

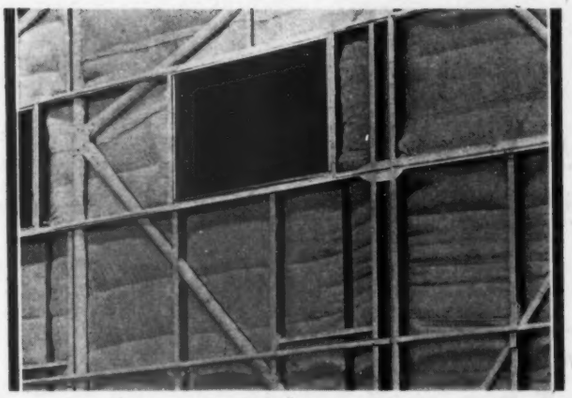
This material weighs approximately 0.19 lb. per sq.ft., 2 in. in thickness, or approximately one-eighth the weight of cork. Due to the wholly flexible and compressible nature of Dry-Zero Aeroplane Blanket no special modification of cabin wall structure is necessary. As this structure is usually tubular, the prevailing method of application is to attach the outer blanket by a wire to the tubular structure. It is used in large sheets covering as much area as possible. The outside shell is then either fastened to wood struts attached to the tubular structure, being fastened to the wood struts through the blanket, or otherwise attached to the tubular structure, but in all cases through the blanket.

The inner blanket is applied in the same way and the interior finish is tacked right to the wood struts, or fastened by wire (if wood struts are not used) to the tubular structure, through the inside blanket. It is to be noted that the interior finish must not be a continuous hard material, otherwise the absorption value of the Dry-Zero Blanket cannot function, and reverberation and building up of noise inside the cabin results. The recommended finishes are either velours, etc., or loosely woven fabrics, or else perforated painted aluminum or duralumin, which permit the blanket to fully function.

This material is not affected by constant vibration or shock, its only tendency under these conditions being to expand in every direction that it can. Its flame proof qualities have been amply demonstrated.

BALSAM-WOOL is the general trade name covering a complete line of flexible insulations, manufactured from wood fiber. While the manufacturing process is essentially the same for all types, there are certain variations in chemical treatment and finish to adopt each type to the specific use for which it is intended. The basis for all types of Balsam-Wool is clean, new wood fiber from Northern coniferous trees. By mechanical and chemical means the wood is broken down into individual fibers; fine, hair-like, hollow tubes. After being saturated with chemicals to render them non-inflammable and resistant to decay, and treated with an adhesive to assure a permanent bond, these fibers are felted into a fleecy mat which looks and feels like sheep's wool. In the production of Balsam-Wool Airplane Insulation this wool mat is lined on one side with water-proof Kraft paper, and on the opposite side with open-mesh cloth. The paper surface is impervious to wind and water, and the cloth surface permits maximum sound absorption.

There are two factors responsible for its high efficiency as a heat insulator, namely—the materials used and the manner in which they are put together. The natural insulating efficiency of wood is vastly increased by breaking it down into individual tubular fibers, and rebuilding them into a "wool" form. Thus the number of air cells is multiplied many times until in its final form, Balsam-Wool is 92 per cent "still" air. Next to a vacuum with mirrored surfaces, "dead" or "still" air is the best insulator known. Air is "still" only when confined to cells so small that it cannot circulate. This material produces this condition to an ideal degree, providing the equivalent of sheep's wool at about one-fifth the cost. The average thermal conductivity does not exceed 6 B.t.u. per in. thickness, per sq.ft., per one deg. F. temperature difference in 24 hr. One inch of this material is equal in insulating efficiency to approximately 3 in. of pine lumber.



Dry zero blanket used in the wall insulation of the Curtiss Condor.

Balsam-Wool is an effective sound absorbent and deadener. The sound coefficient at C-4 (512 vibrations per sec.) is usually taken as a measure of efficiency. At this note, one in. Balsam-Wool Airplane Insulation will absorb 56 per cent of the sound, and the ½ in. thickness will absorb 41 per cent.

The flexibility of this material allows it to fit snugly over irregular areas and into odd shaped places. It fits easily around braces or corners and seals up every crack and crevice. Its installation costs are small, as any workman with a pair of shears can easily and quickly apply it. There is no waste, as it remains intact when cut in small pieces. Each fiber is coated with an adhesive which permanently cements it to adjacent fibers.

This material is given a chemical treatment that renders it non-inflammable. Since it is 92 per cent "still" air it is very light. It is stacked in 34 in. widths, one inch and one-half inch thick. The former thickness weighs 30 lb. per 100 sq.ft., and the latter 18.

Felts, cotton, and cork also have been tested and used as insulation.

THE COMBINATION of all these many materials into a specific interior is distinctly the work of the decorator. No matter how pleasing each individual item, no matter how practical each is for the purpose intended, no matter how costly, the entire effect can be ruined by one bad clash of colors. Blending these multitudinous possibilities into one assembled interior, is a distinctly artistic endeavor.

In the growing competition to give planes greater luxury — distinctive comforts, smart refinements — leading airplane manufacturers are becoming cognizant of the importance of this field, until recently neglected. It is a field for the trained expert, as the selection of materials and more particularly colors, is of prime importance. Every material referred to in this article, as well as many others, has its distinct place in the interior decoration of airplanes. True beauty pleases and creates confidence—whether it is expressed in a plane, a building, a bridge or a motor car.

NOTES ON MEETING THE PUBLIC

By C. L. Funnell

Incidents such as those recounted by Mr. Funnell are uncommon and are becoming more so. They can, however, still be encountered from time to time. Editors of this magazine have had occasional experiences quite as disturbing as these, even in recent months. Air transportation will be judged as a whole by most of its potential patrons.

PLANES are good and getting better. Radio communication is improving rapidly. A fair supply of transport pilot talent is in sight. Available fields are increasing, and so are beacons. Things are being done for the air transport business and it is doing splendid things for itself . . . except, occasionally, in relation to its possible customers.

Everyone agrees that the first step in transforming a lay member of the public into a customer of air transportation is to get him into the air. Make a favorable impression and he flies again. Another pleasant contact and he accepts the modern mode as something that fits his sphere of life. With luck he will make a habit of flying for business and pleasure.

Now this lay member of the public upon whom we are all training our artillery is probably over 35. He has never flown. He is apt to scuttle for the wind'ard rail when a catboat heels over five degrees in a no-reef breeze and he thinks 45 m.p.h. in a motor car is reckless motoring. And he is equipped with the means to travel as he pleases, to take instructions if he is so inclined, and to own and maintain an airplane.

Here's a true story that deals with the first flight of a man who ought to become a customer. The plane had taken off and was flying smoothly over interesting country. Our first-flighter asked the co-pilot what factory lay below. "Sorry," said the co-pilot. "It's by me. This is my first trip over this line."

A moment later the steward-assistant pilot relieved the gentleman at the controls and what had been very smooth flying became irregular. Over-controlling, maybe. When the first flighter landed he stayed landed. Why? He had a bad ten minutes while that assistant pilot, who had blandly confessed unfamiliarity with the country, was demonstrating his apparent unfamiliarity with the plane. Remedy: just a few hours of preparation for the job. Possible result: another lasting customer.

And here is an example of how the airport resists new business. An industrial executive who flew in forest green during the war had recently invested the time, trouble and cash to get a private pilot's license. Finding himself in a new city with two hours between trains he drove out to an airport with the idea of putting in a little time and having a look at the place from the air.

After ten minutes of disinterested talk on the part of the hangar man, a plane was finally checked, filled up and put on the line. Mr. Private Pilot flew around for an hour, landed, and taxied in to settle his account. Was he thanked and invited to drop in whenever he was in town? Was he asked to look over the new planes around the hangar? Did they want to know how he liked the airplane he had flown?

No, is the answer to every question. The man who accepted the cash made it evident that the whole transaction had cut heavily into his leisure for the afternoon.

One more airport story illustrates another phase of imperfectly polished contact with customers-who-might-be. Recently I had an errand in a city a few hours away by train and a few minutes away by air. I heard there was an airline operating to the point in question, with a hangar at X Airport.

I arrived at the airport and approached the first building I came to. It had a window in it, and I asked the man inside where I could get my time-table. He was busy with a hot dog sandwich, which he had just succeeded in biting. I couldn't have come at a more inopportune time. He poked his thumb over his shoulder and so I went on to the next building.

This building had an open door, through which I saw a man sitting at a desk. I went in and told my story. The man had completely overcome all curiosity. Or else he could visualize people by hearing them speak. He did not look up. He reached around to a table at his back, picked up a mimeographed sheet and handed it to me. This man could have been eating a hot dog, too.

There was an airplane in the adjacent hangar, and I strolled over to look at it. Along came a pleasant, slender person with a neat mustache.

"I wonder if I can help you any?," he said. "I heard you asking questions at the office. Maybe I could tell you something about the line. I'm flying the afternoon trip."

He could and did help a lot.

"Say,' he suggested, "it's a long walk over to that bus line on the main road. And it's hot. Let me drive you over in a car. Got one right here. When are you making your trip? I can have a company car pick you up at your office."

That's what I mean. A pilot, service-minded. He sold me completely on his line. If I'd never flown, was afraid to climb apple trees and got dizzy hanging pictures, I think he would still have sold me. We need men with that pilot's viewpoint in every job in air transportation which has contact with the public. Ticket clerks, information people, bus drivers, porters, stewards, pilots, traffic managers and presidents.

Transport and Engineering

A DESIGNER'S NOTES ON INTERFERENCE

WIND channel and other tests show that the resistance of two bodies in close proximity to one another is rarely equal to the sum of the resistances of the two bodies when isolated one from the other, and yet performance estimates for new planes must necessarily be based on the complex summation of the resistances of a large number of parts. The "interference effect" may therefore account for wide divergence between estimated and accomplished performance, a fact of which undue advantage is too often taken by engineers of the optimistic type.

This factor of ignorance has been attacked in a number of aerodynamic laboratories and test fields the world over. If any generalities can be drawn from the resulting data, they would seem to be that the larger the scale of the tests, the more accurate the results, and that few basic principles for predicting and overcoming this effect have yet been advanced.

Much can be done in the full scale wind channels which are in existence or being built at the present time, nevertheless there must be a great deal of information on the subject which has never been published, and it is suggested that all aircraft designers, who have experienced, and particularly, who have been able to overcome, interference effects, would be doing a useful service in making a public account of the facts.

Pending some such general pooling of experience, the following notes, necessarily somewhat scrappy and disjointed, may be of interest.

One of the most striking cases of interference yet recorded was observed by a German authority in the course of tests on airship bodies. On sticking a pin into a large wooden airship model of low resistance, the total drag was increased to three or four times that of the model alone, and by an amount far greater than could conceivably be regarded as the resistance of the pin itself.

The conditions are roughly indicated in Fig. 1. Investigation showed that the presence of the pin had provoked a region of turbulent flow, spreading out behind it until the whole tail of the model was practically enveloped by turbulence. In general, it seems safe to assume that all cases of interference of a serious nature, are the result of provoking turbulence by the interfering body. This turbulence in turn disturbs the flow in the boundary layer of the body interfered with, and causes a breaking away of the flow around the latter.

A still more interesting case has been placed on record by the Rijks Studiedienst fur Luchtvaart of Amsterdam. Tests were being made to discover the best arrangement for the characteristic "cutaway" in the center of the leading edge of the wing of a Fokker mono-

Fig. 1: The turbulent area caused by the pin is indicated by the dashed lines.

plane, in way of the pilot's head. When the mutilation of the leading edge extended a little too far upward, the characteristics of the model changed suddenly. The nature of the change was precisely similar to that which would have occurred if the aspect ratio of the wing had suddenly been greatly reduced. The drag at small lift coefficients was slightly increased, but the increase was proportional to the square of the lift, and became very large at large lift coefficients (Fig. 2).

The "cutaway" had provoked turbulent flow, and consequent almost total disappearance of lift, over the central section of the wing. The two outer sections continued to lift normally, but produced the induced drag proper to two separate wings of approximately half the actual span of the model.

This case is typical of a kind of interference of great practical importance, which is probably far more common than has been generally recognized. The example cited is perhaps an extreme case, and when described, the nature of the effect is fairly easily understandable. The results of many tests made in the Boulton & Paul wind channel show that the interference between fuselages, engine nacelles, strut ends, etc., and wings, have very frequently this same characteristic of apparently increasing the induced drag of the wing system. That is, the interference resistance increases as the square of the lift coefficient developed by the wing system involved.

When "induced interference" of this type is found, it is usually also found that there is an accompanying fall in the lift corresponding to any given angle of attack, just as would occur if the aspect ratio had been physically reduced.

The induced drag of a wing is always small at small angles of attack. The effective reduction of aspect ratio caused by "induced interference" reduces the lift, and hence tends to reduce the total induced drag, at a given angle of attack, and if model tests are made only over a small range at small angles of attack, the importance of this effect may easily escape notice, particularly if drag measurements only are made, and the change in lift caused by interference is not observed.

As the change in drag at small angles caused by this type of interference is small at small lift coefficients, the top speed of the machine so affected will be little reduced. As the interference drag increases very rapidly with lift, it becomes serious at climbing speed, and in level flight at high altitudes. Interference of this kind will thus explain the many hitherto puzzling cases of machines which have given the estimated top speed at sea level, but have failed badly to achieve their expected climb and ceiling.

Another feature in machines having serious interference of the induced type is a very marked increase in the landing speed. This is in part due to actual loss of lift, but in some cases the ele-

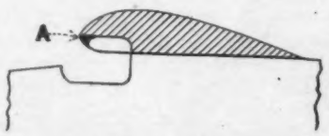


Fig. 2: Removal of the small portion of leading edge A (shown in black) led to a great increase in induced drag.

vators are not sufficiently powerful to hold the machine at the large angle of incidence corresponding to maximum lift on the greatly reduced effective aspect ratio.

During the World War a case came to light, evidently of this type, which gives a striking example of how small a cause may lead to serious effects on airplane performance. It was desired to modify a machine of a well-tried type to fit it for shipboard use. The main modification was the fitting of folding wings. This involved the fitting of a hinge joint in the rear spar, and the provision of a jury-strut between top and bottom front spars at their inboard ends to keep the wing cellule in shape when the wings were folded.

The jury strut fitted was a perma-

nent fixture, and with the wings in flying position it lay close to, and parallel with, the side of the fuselage, and the strut from the fuselage to the top centre section wing.

On testing the modified machine it was found that the top speed at sea level had dropped about 5 m.p.h., the ceiling had been reduced from 20,000 ft. to about 10,000 ft., and the stalling speed had risen by over 10 m.p.h., at the same all-up weight and wing-loading. When the jury strut was removed the machine reverted at once to normal performance.

The jury strut in question was of normal streamline type, and of the same section as the centre section strut to which it lay parallel. The gap between the two struts was something of the order of one strut width. The jury and centre section struts were replaced by two half-streamline sections, so arranged that in the flying position of the wings the flat on the jury strut lay close to the fuselage, and met the flat on the centre section strut so that the two combined to form a single streamline section, and the performance of the original type was recovered to within very small limits.

That interference had the effect of apparently changing the effective aspect ratio of wings was first recognized, so far as can be discovered, by the late M. Eiffel. He placed on record nearly ten years ago, that the effect on a model wing of supporting struts attached to the upper surface of the model was to reduce the effective aspect ratio, whereas similar supports attached to the lower surface appeared to increase the effective aspect ratio. There now exist a good deal of evidence showing that the interference effect on a wing of a body in close proximity thereto usually varies with the lift of the wing and that this variation generally consists of a rapid increase of interference as the lift rises when the interfering body is above the wing, but when the interfering body is below the wing the variation is sometimes the reverse, that is, the interference decreases with increasing lift.

Interference may be beneficial. The drag of two circular wires, one behind the other, has long been known to be considerably less than that of a single wire if the distance apart of the two is relatively small.

The Handley Page slot, when added to a stalled wing, reduces the resistance of auxiliary airfoil and the main wing to a value far less than the resistance of the main airfoil alone. It is therefore quite possible that the effect claimed to have been observed by M. Eiffel, of a definite improvement in the drag of a wing, similar to that which would occur if the aspect ratio had been increased, might result from interference. Unfortunately the evidence available suggests that harmful interference is much the more common phenomenon, except in so far as the use of devices such as the Handley Page "slot" the N.A.C.A. cowling, and the "Townend ring" may be regarded as examples of beneficial interference.—W. H. Sayers

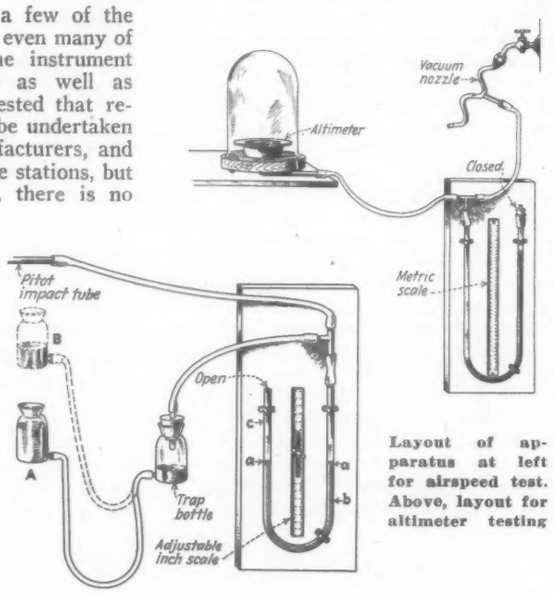
FIELD-TESTING ALTIMETERS AND AIRSPEED INDICATORS

THE neglect of instrument testing and upkeep which is the rule at the vast majority of American airports is as shocking as it is regrettable. Maintenance organizations, which would not hesitate to undertake the most difficult of engine or plane problems, calmly accept and share with the average pilot, the conviction, that airspeed indicators are never accurate after a few weeks' use, that altimeters cannot possibly be right, and that compasses are in league with the devil.

Most of the lines and a few of the operators know better, but even many of these rely entirely on the instrument manufacturer for testing as well as overhaul. It is not suggested that repair or rebuilding should be undertaken by anyone but such manufacturers, and completely equipped service stations, but in the majority of cases, there is no more need to dismount, carefully pack, and ship an instrument to the manufacturer for test, than there is to do the same thing with an engine, when a cylinder or two misses fire.

As an illustration of the real simplicity of the apparatus and technique required for such a mysterious business, we offer the equipment for field-testing air speed indicators and altimeters recently constructed by C. S. Draper of the aeronautical department of M. I. T. and Paul Battilana, of the Boston Curtiss-Wright Flying Service station.

In the airspeed indicator test, the instrument does not even have to be removed from the plane. A rubber tube is fitted over the dynamic, or open, member of the pitot static unit, and is lead to a T-connection, which has been mounted on a board with a simple open-ended U-tube partially filled with water. The second leg of the T-connection is coupled with one end of this U-tube and over the third leg is fitted another rubber tube, which leads through one aspirator bottle to a second, which is also filled with water.



Layout of apparatus at left for airspeed test. Above, layout for altimeter testing

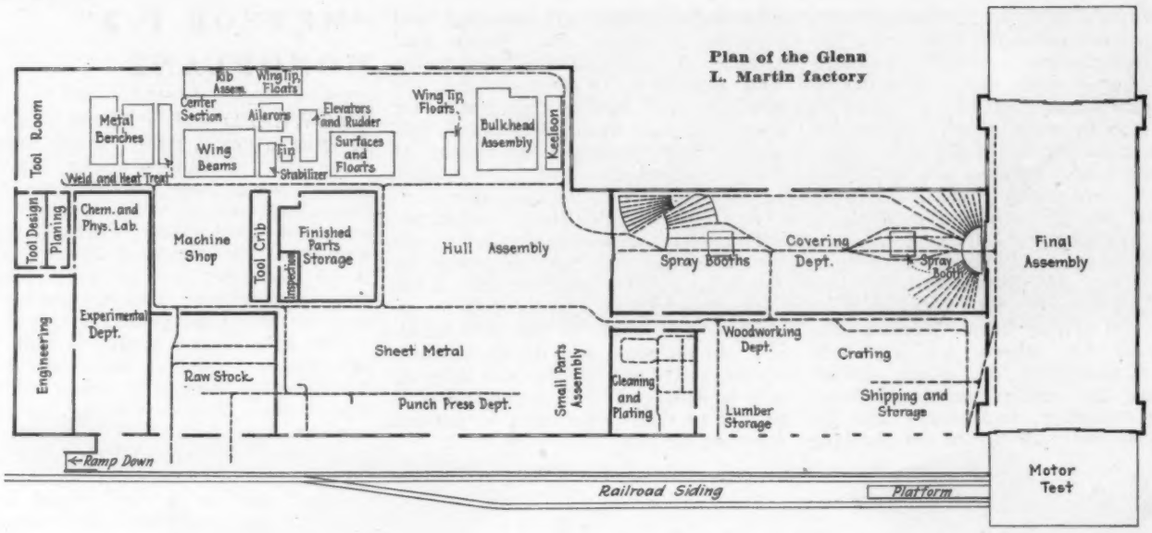
When first connected, let us say, the second bottle is at position A, as shown in the accompanying diagram, and the water in the U-tube is at equal heights a-a. Simply raising the second bottle, increases the pressure in the entire system and produces a reading on the airspeed indicator and a difference of level in the heights of the water in the two legs of the U-tube. Let us say, the water now stands at b and c. The vertical distance between b and c measured on the scale mounted between the legs of the U-tube is, of course, the pressure head, in inches of water, and should correspond with the meter reading in miles per hour as shown on the accompanying curve. The first bottle serves simply as a water trap, and insures that no liquid is forced up into the pitot tube or meter.

Beside the direct calibration possible with this apparatus, it also indicates whether there are any leaks in the tubing or connections between the pitot static unit and the instrument, such a condition allowing the water head to decrease, while the pressure bottle is held in any given position for a few seconds. To such leaks can be ascribed

Altitude in feet	Pressure in milimeters of mercury
0	760.0
1,640	716.0
3,281	674.1
4,921	634.2
6,562	596.2
8,202	560.1
9,842	525.8
11,482	493.2
13,123	462.3
14,764	432.9
16,404	405.1
18,045	378.7
19,658	353.8
21,325	330.2
22,966	307.9
24,606	286.8
26,247	266.9
27,887	248.1
29,528	230.4
31,168	213.6
32,808	198.2
34,449	183.5

Airspeed (m.p.h.)	Head of water in inches
0	0.00
20	0.20
40	0.70
50	1.15
60	1.70
70	2.30
80	3.05
90	4.00
100	5.00
110	6.05
120	7.15
130	8.35
140	9.70
150	11.10
160	12.75

Above: Airspeed vs. waterhead table for airspeed indicator test. Left: Standard atmosphere table for an altimeter test.



Plan of the Glenn L. Martin factory

the vast majority of airspeed indicator troubles. For example, eighteen of the first twenty planes tested suffered from installation leakage while only one meter was found definitely inaccurate and had to be returned to the factory.

The equipment for testing altimeters is just as simple, but in this case the instrument must be removed from the plane. It is placed under a glass bell jar, which in turn stands on a base, in the bottom of which is an L-connection. Over this L is fitted a rubber tube, which connects the bell jar with a mercury filled U-tube barometer and a simple vacuum producing deflector nozzle, which can be mounted on any convenient water faucet. Again the meter reading is checked against the difference of level in the two legs of the tube, the proper values again being taken from a standard curve as shown. Attention is called to the fact, that in this case one end of the U-tube is kept closed and there will be always a large initial difference in the two mercury levels.

The rubber and glass tubing, corks, meter stick, vacuum nozzle and bell jar needed for this equipment can be secured at any chemistry supply house, as can the aspirator bottles, though almost any type of tubes or flasks can be made to serve in the airspeed layout.

BUILDING THE FACTORY AROUND THE ORGANIZATION

WHEN one of the oldest and most successful airplane manufacturing organizations in the country, has an opportunity to design, build, and equip an entirely new factory for itself, the industry has a right to expect an advance in its standards of plant layout and functional efficiency. The new home of the Glenn L. Martin Company not only achieves a new level in aeronautical development but indisputably takes its place with the best examples offered by any industry in the country.

For twenty years, a Martin organization has been manufacturing airplanes. For the large majority of this time the product has been destined for the military air services. At present their emphasis is on metal construction of large seaplanes, though by no means exclusively so. We should therefore visualize a highly developed activity of design, development, and construction of a diversity of high performance types, which must meet the severest of inspections and tests throughout the entire course of their fabrication.

The selection of the location was the result of months of study. The general neighborhood of Baltimore was finally chosen, because it combined the important item of an ice-free seaplane base with an extensive supply of skilled labor and a nearness to all the Eastern sources of material. The site itself is a 1,200-acre plot, 9¼ mi. from the center of Baltimore, lying between the Pennsylvania Railroad and Chesapeake Bay. There is, of course, ample room for a seaplane base and a large flying field, which have already been built. Incidentally, the field is being used by the Ludington Line as their Baltimore terminal.

The plant itself loses no impressiveness in this vast area. The main building is 933 ft. long by 273 ft. in width, a floor area of almost six acres. And this represents only the first third of a ten-year expansion program! At one end of the main building is a single story office building, which houses the officials of the company, the accounting, and the purchasing departments. All other departments are considered as part of the direct manufacturing organization. The end of the factory nearest the office building is occupied by the engineering, experimental, tool designing, tool making, and production planning departments, and the chemical and physical laboratory. It is in this grouping that the key to the entire organization and factory can be found.

Let us follow a plane from the time it originates as an executive order to the time it is shipped from the factory as a unit of regular production. The Martin company has long used a combination of the project system of engineering, which intrusts the complete design of a plane to one man, and the group system, which sub-divides the responsibility among a number of engineers specializing in some particular portion of the work. The Martin system utilizes the group under the supervision of a single, responsible, coordinating head. Plans developed under such a system are taken into the adjacent experimental department. First a mock up, then the various parts and finally a complete plane are built and fully tested. The design features are developed not only from a technical standpoint but from a manufacturing one as well. The nearness of the tool departments and the production planning office is not accidental. The men in charge of the experimental fabrication, are experienced in all the ramifications of manufacturing technique. By the time a plane has been built as an experimental unit and test flown it has been worked out not only as a successful aircraft but as a practical article of manufacture. As soon as a production order is imminent a conference of the manufacturing, engineering and purchasing departments is held. The planning system used is one of scheduling from the finishing date backwards rather than working from the other end and chancing cumulative delays. The Martin organization is exceptional in that the production planning department and the inspection department are

ranked as a part of the manufacturing organization and report only to the factory departments in which they function. Consequently the friction and inefficiency which exists between these departments in many factories is avoided.

The actual flow of material and parts through the building is extremely simple, considering the diversity of product and the resulting necessity of installing universal machinery. As can be seen from the plan view the machine shop, the punch presses, and the sheet metal department, are all adjacent to the stores of raw stock. Beyond these divisions lie others, which handle larger assemblies or, which further process the smaller units. Between these secondary departments and the final assembly are placed the finishing departments where all spraying and covering is carried out. From final assembly the plane can be taken to the field for flight or disassembled and taken to the crating department for shipment. An overhead monorail system greatly facilitates movement of material about the plant. It is shown as a broken line in the diagram.

Expansion possibilities are almost unlimited. The most imminent plans are for enlarging the final assembly by lengthening it at either or both of its ends or by adding another area by increasing the length of the main building. In the same way the departments of raw stores and crating and shipping will be enlarged. The general plan is to add to each department as demand warrants it.

Flying Equipment

HANDLEY-PAGE "HANNIBAL"

INTO the select group of huge, passenger land-planes, hitherto monopolized by the Junkers G38 and our own Fokker F32, must now be admitted a British member. Powered with four Bristol Jupiters, delivering a total of 2,000 hp., the Handley-Page "Hannibal" furnishes accommodations for 40 passengers and is designed for a top speed of 120 m.p.h. with a gross load weight of 30,000 lb. Tested recently at the Radlett aerodrome, it was pronounced entirely satisfactory. It is said to have a landing speed as low as 50 m.p.h.

The biplane wings are of conventional two spar fabric-covered type. The interplane bracing, however, consists entirely of struts, so arranged as to give two bays in the upper wing and one in the lower, outside the center and stub sections. The four engines are all mounted as tractors and are as close together as possible to increase controllability in case of partial failure. Their nacelles are built integrally into the lower part of the upper, and the upper part of the lower wing.

The fuselage is exceptional to say the least. The control compartment, radio room, and forward cabin all project in front of the lower wing. Opposite the engines, are lavatories, luggage compartments, and a bar, and to the rear is a second passenger cabin. All the above listed parts of the fuselage are of semi-monocoque duralumin construction. From the rear of the cabin to the tail the construction changes to a fabric covered steel tube system.

No servo control is used. Ailerons are mounted on the top wing only and are preceded by slots on the leading edge. There are three rudders and two elevators, the top one of which is equipped with an adjustable stabilizer. The landing gear is extremely simple and is fitted with brakes.

It is planned to use a number of these planes on various parts of the routes operated by the Imperial Airways, the first of them being destined for service in India. Construction has been started on a fleet of eight of these airliners, which have been ordered at a total price of slightly less than $1,000,000. Specifications of the Hannibal follow:

Span, upper wing	130 ft.
Area, upper wing	2,000 sq.ft.
Area, lower wing	990 sq.ft.
Length	86 ft. 6 in.
Pay load	8,700 lb.
Gross load	30,000 lb.
Wing loading	10 lb. per sq.ft.
Power loading	15 lb. per hp.
Top speed	120 m.p.h.
Cruising speed	105 m.p.h.
Initial climb	600 ft. per min.
Service ceiling	12,500 ft.

"METEOR P-2" MONOPLANE

POWERED with a Kinner K-5 engine, a new 2-place training monoplane of conventional strut-braced, parasol wing, open cockpit type has been introduced by the General Western Aero Corporation, Burbank, Cal. Known as the Meteor P-2, the plane is of steel-tube fuselage and wooden wing construction. Fabric covering is used for both fuselage and wing.

The wing of the Meteor is built in two panels, joined at the center and braced to the fuselage by center-section type struts. Engine cowling, cockpit cowling, rear portion of the fuselage quarter-deck and the pilot's head-rest fairing are all of buffed aluminum. Landing gear is of rigid tripod type without shock-absorbers and mounts Goodyear Airwheels.

Designed by Albin K. Peterson, former chief engineer of the Kreutzer Aircraft Corporation, the Meteor has been granted NC license No. 188W. Specifications, as given by the manufacturer, are:

Span	32 ft.
Chord	63 in.
Total wing area	163 sq.ft.
Length	24 ft.
Height	7 ft. 10 in.
Weight empty	1,020 lb.
Gross weight fully loaded	1,650 lb.
Fuel capacity	30 gal.
Oil capacity	3 gal.
Engine	Kinner K-5 (100 hp. at 1,810 r.p.m.)

TAYLOR "CUB" LIGHT PLANE

A LIGHT plane, featuring a comfortable cockpit for pilot and passenger, with easy entrance through a drop door, has been put on the market by the Taylor Brothers Aircraft Corporation of Bradford, Pa. An 8-gal. fuel tank is incorporated in the center section of the parasol wing, which is externally braced by two struts on each side, and drift wires. The landing gear includes

The Handley-Page Hannibal, powered with four Bristol Jupiter engines

Right: Meteor Kinner-powered training monoplane. Below: Taylor Cub two-place light plane with a 9 cyl. Salmson engine. Lower right: Kinner-powered three-place Lincoln cabin monoplane. Lower left: States Aircraft two-place open monoplane, fitted with special N.A.C.A. cowling.

shock cord absorbing units in addition to the low-pressure tires. Aileron control wires are placed outside, allowing easy and constant inspection. The original model was equipped with a 9-cyl. Salmson engine, but at present the 40-hp. Continental is used, with still other types optional. Dual control can be installed. With the 40-hp. engine, the performance, according to the manufacturer, is: top speed, 72 m.p.h.; stalling speed, 32 m.p.h.; initial climb, 750 ft. per min.

Span	35 ft. 4 in.
Length	21 ft. 9 in.
Height	6 ft. 8 in.
Wing area	184 sq.ft.
Weight, empty	450 lb.
Gross weight	850 lb.
Wing loading	5.1 lb. per sq.ft.
Power loading	21.3 lb. per hp.

LINCOLN CABIN PLANE

AN ATTRACTIVE 3-place cabin plane is offered by the Lincoln Aircraft Company, Inc. of Lincoln, Neb. Powered with either the Kinner B5 or K5, it holds approved type certificates 372 and 373. The wing structure of I section spruce spars and bass wood ribs and the chrome molybdenum tube fuselage, are fabric covered. Standard equipment includes brakes, semi-balloon tires, oil-draulic shock absorbers, and Duolite shatter-proof glass. The dimensions follow:

Length overall	26 ft. 0 in.
Height overall	8 ft. 3 in.
Wing span	37 ft. 0 in.
Wing chord	72 in.
Wing area	206 sq.ft.
Weight emply (B5)	1,352 lb.
Weight empty (K5)	1,320 lb.
Gross weight (B5)	2,180 lb.
Gross weight (K5)	2,148 lb.

STATES AIRCRAFT MONOPLANE

THE States Aircraft Corporation of Chicago Heights, Ill., has just placed its first model on the market. Holding A.T.C. 349, the plane is a Kinner powered, two-placed parasol monoplane for the school and private owner. Interesting features are low pressure tires as standard equipment, a two panel wing without center section and an adaptation of the N.A.C.A. cowling which allows the cylinder heads to protrude to facilitate servicing. The dimensions furnished by the manufacturer are:

Length	23 ft.
Height	8 ft.
Span	32 ft.
Chord	6 ft.
Airfoil section	Clarke "Y"
Engine	Kinner K-5
Landing gear tread	84 in.
Wing area	192 sq.ft.
Weight empty	1,083 lb.
Weight loaded	1,635 lb.

KINNER 210 HP. ENGINE

MANUFACTURED under A. T. C. No. 62, the new Kinner C-5 210 hp. five cylinder air-cooled radial aircraft engine marks the entry of the Kinner Airplane and Motor Corporation into the intermediate power range of the engine field.

The C-5 has the same general arrangement of parts as the two smaller Kinner engines, the 100 hp. K-5, and the 125 hp. B-5. As are the smaller Kinner engines, the new C-5 is characterized by marked simplicity. Induction is accomplished without supercharger or rotor, all accessories are driven by simple spur gears and plumbing is held to a minimum. Plain bearings are used throughout except for the deep groove

type ball thrust bearings which carry crankshaft end loads.

With a displacement of 715 cu.in. the C-5 weighs 420 lb. dry, has an overall diameter of 50 in. and an overall length, without starter or generator, of less than 35 in. Bore is 5⅝ in., and stroke 5¾ in. Standard mountings are provided for starter, generator and fuel pump.

Cylinders are of the distinctive Kinner type, featuring the flat bolted head joint, barrel to head, barrels being interchangeable. Cylinder heads are of modified "Y" alloy with pompadour-type finning. Pistons are full skirt ribbed type of Bohnalite alloy, with three compression and one oil ring, all above the piston pin. Piston pins are of full floating type secured by aluminum buttons in the ends.

The crankshaft is of one piece construction with No. 30 S.A.E. spline end for propeller hub. Main bearings are bronze backed with thrust bearings of the deep grooved race ball type.

Tulip type intake valves of chrome silicon steel are 2⅛ in. in diameter. Exhaust valves are of chrome nickel silicon steel, 2⅛ in. diameter. Valve lift is ⅜ in. Valve gear is completely enclosed with rocker arms of hollow axle type on plain bronze bearings lubricated from Alemite fittings, feeding lubricant from the bearing edges. Push rods are ball ended with screw and lock nut adjustment on the valve end of the rocker arm. Each set of valves is operated by an individual camshaft.

Spur gears are used throughout the engine. Cam gears are driven by a pinion attached to the crankshaft by means of jaws and a bolt. This pinion also carries a jaw so that the starter engages directly with the rear end of the crankshaft. Magnetos, generator, fuel pump and oil pump shafts are driven direct from camshaft gears. The fuel pump turns at engine speed, the tachometer at one-half engine speed, while oil pumps, generator and magnetos are run at one and a quarter engine speed.

Lubrication is of conventional dry sump type with an external tank, pressure pump, and scavenging pump. Oil from the tank is forced through lines cast into the crankcase to the front main bearing, thence into the crankshaft and up to the crankpin, where it feeds to the crankpin journals and is pressure fed to the link pin bearings. It is then forced through the rear main bearing into a duct in the crankcase to the relief valve located between No. 1 and 2 cylinders. From the relief valve the oil discharges into the upper part of the gear case and drains from the case into the sump where it is picked up by the scavenging pump and returned to the tank.

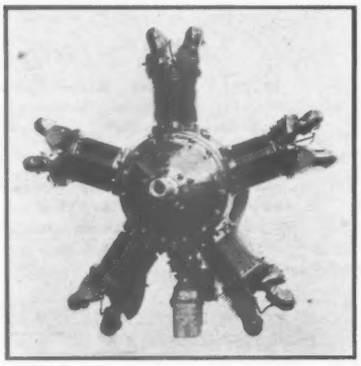
The aluminum alloy crankcase is built in three sections. The nose section carries the thrust and front main bearings, the center section carries cylinders, rear main bearing, and front camshaft bearings, and the rear section contains the intake manifold, carries the rear camshaft bearings, and mounting flanges for all accessories.

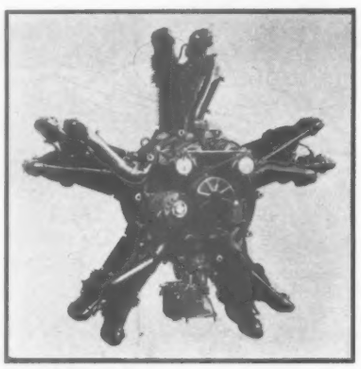
The C-5 engine is equipped with either Stromberg NA-R-7 or Holley 439 carburetors of single-barrel accelerating well type, and so located that either gravity or pressure fuel feed may be used. Ignition is furnished by two Scintilla PN5-DF1 magnetos, flange mounted. The engine can be equipped with nose type exhaust collector ring or individual exhaust stacks.

Specifications and dimensions, as supplied by the manufacturer:

Rated horsepower	210 at 1,900 r.p.m.
Maximum horsepower	240 at 2,200 r.p.m.
Oil consumption	0.015 lb. per hp.-hr.
Fuel (full throttle)	0.60 lb. per hp.-hr.
Bore	5⅝ in.
Stroke	5¾ in.
Displacement	715 cu.in.
Compression ratio	525 to 1

Weights and dimensions: Engine weight dry, 420 lb. (without hub, starter, generator, fuel pump, or exhaust collector ring); weight of nose collector ring, 40 lb. (including air heater); maximum overall diameter, 50 in.; mounting bolt circle diameter, 19¼ in.; length (without starter or generator), 34⅛ in.; distance from mounting plane to center line of propeller, 23¾ in.; center line of propeller to center of gravity of engine, 13¾ in.





Front and rear views of the Kinner C-5 engine

"WATER SPRITE" SEAPLANE

ONE of the most troublesome problems of seaplane design, has been to reduce corrosion of metal wing parts. The adoption of cadmium plated, mild steel, ribs manufactured by the Aerotruss Company, is therefore one of the most interesting features of the Water Sprite. This four-place dual control seaplane was built by the Marine Aircraft Company of Sausalito, Cal. The hull has a frame of oak, ash, and spruce, and is sheathed with Alclad. All fittings are of welded mild steel cadmium plated against corrosion. An amphibion landing gear is furnished as an optional feature. Equipped with the Comet 7-cyl. 165 hp. engine, the plane has the following performance as reported by the manufacturer: Maximum speed, 114 m.p.h.; calculated landing speed, 55 m.p.h.; climb, 731 ft. during the first minute; ceiling, 12,450 ft.

The Water Sprite, four-place seaplane

Length	23 ft. 3 in.
Height	9 ft. 5 in.
Span, upper	34 ft. 0 in.
Span, lower	32 ft. 0 in.
Mean chord, upper	5 ft. 8 in.
Mean chord, lower	3 ft. 4 in.
Wing area	253.0 sq.ft.
Weight empty	1,612 lb.
Gross weight	2,500 lb.
Wing loading	9.8 lb. per sq.ft.
Power loading	15.1 lb. per hp.

APPROVED TYPE CERTIFICATES

DURING the period Nov. 30 to Dec. 20 the Aeronautics Branch of the Department of Commerce issued the three following Group I Approved Type Certificates: 383 Spartan, 64-300 (Wright 300 hp.); 385 Nicholas Beazley, NB 4 L (Lambert 90 hp.); 386 Nicholas-Beazley NB 4 W (Warner Scarab Jr. 90 hp.).

The Salesman's Notebook

FLYING VERSUS LIFE INSURANCE

[Life insurance may seem an odd subject to consider under the head of airplane salesmanship, but it is one of the salesman's major problems. There is almost as much speculation as ever about the legal position of the owner of an insurance policy taking a ride in an airplane, and the fear of loss of validity of existing policies or of an inability to get new insurance protection if one goes flying, make a generous contribution to sales resistance. The attached correspondence speaks for itself. We answered the question with which Mr. Campbell closed his letter with an enthusiastic affirmative.—ED.]

"A year ago at a meeting of the Aviation Committee of the United States Chamber of Commerce, held in Columbus, I made a statement that the insurance companies were acting as a deterrent to the promotion of the aviation industry. A number of the folks present didn't like it but I persisted.

"There must be a hundred thousand life insurance agents in the United States scurrying around asking people for business. When they get a prospect to the point of signing an application, they immediately scare the gizzard out of him so far as flying is concerned. It doesn't seem to me that this does aviation any good.

"Even the man who hasn't the remotest idea of flying is asked whether or not he rides in airplanes, the implication being that he can't get insurance if he rides.

"I explained the whole thing to Ray Cooper and since then he has been keeping a check on his own experience so far as life insurance is concerned. I received the following memorandum. Maybe it's good enough to print in your publication. What do you think?"—Harvey Campbell, vice-president and secretary, Detroit Board of Commerce.

By Ray Cooper

WELL, Chief, I got hooked this morning. The representative of a big life insurance company has just laid a policy on my desk, at the standard rate for my age and without any increase because I take an occasional flight in an airplane. Now all I have to do is dig up the money to pay for it.

You know what my job is, Chief, but just for the sake of getting the whole picture before us let me state it as it appears to me. I am an assistant secretary of a Chamber of Commerce especially detailed to the Aircraft Division. I am expected to assist in encouraging the industry and more especially as it applies to its development in our community. I am not required to use the airplane as a personal means of transportation at any time although I am permitted to do so when, in my opinion, it is safe and expedient. That I do use it on occasion is a matter of choice with me and, as you know, I am pretty fussy about the ability of the pilot with whom I ride.

Acting on your suggestion I let it be known among my friends that I was in the market for additional insurance and, within a few days, the first salesman called on me. He told me all about his company and painted a glowing picture of what I could expect in the way of service and ultimate results, finishing his sales talk by producing the usual application. He asked the usual questions about name, age, place of birth, relatives living and dead and then came the question, "Have you ever taken a ride in an airplane?" That is where the music ceased. When I answered yes he stopped and dug into his brief case but failed to find the paper he apparently sought. He then explained that he would have to return to his office and get a special aviation questionnaire form. He finished the application, which I signed, and then departed. I have never seen or heard from him since.

Three or four days later the representative of another company appeared and apologized in the usual manner for taking my time over life insurance. When we came to the matter of whether or not I had ever taken a flight he had the questionnaire, which we filled out. Here is one of them and this is the way it reads:

BLANK INSURANCE COMPANY

Passenger's Aviation Supplement

For any applicant for Life Insurance who has taken a flight in any type of aircraft or who submits an affirmative or indefinite answer to any question in the application concerning aerial flights.

1. Do you now hold or have you ever held a pilot's license for aircraft? (If this is answered "yes" fill out Pilot's Aviation Supplement instead of this one).

2. Have you ever owned or operated an aircraft?

3. Give actual dates of last two flights.

4. a. Give number of flights, hours in air and mileage either as passenger or pilot during the last three calendar years.

	No. of flights	No. of hours in air	mileage
Present year	...	.....	.....
Past year	.....	.....	.....
Preceding year	.	.....	.....

b. Give number of flights you have ever made.

c. Give total number of flights on fare-paying scheduled routes. In privately owned planes. Government or state planes. Local or sightseeing planes. Other flights.

5. Between what points were your three longest flights made?

6. Were flights which you have made at any time for pleasure, in connection with business or while in government service?

7. Have you a relative or friend who owns or operates an aircraft? If so state relationship and address.

8. a. Do you hold a commission in the Aviation Section of the Army, Navy, Marine Corp, Officers Reserve or in the National Guard Air Service?

b. When does your reserve commission expire?

c. Do you intend to renew it?

d. Have you flown during the past two years in connection with your duties as a reserve officer?

9. Are you connected in any way with Government or State Aviation Units? With aeronautical manufacturing, sales or financing? With the establishment or maintenance of an airport? With an Aero or Flying Club? Does your business bring you in any way into contact with aviation? Give details.

10. What plans have you to fly in, own or operate an aircraft during the next year?

11. Do you intend to fly in a plane owned by a private individual or by your Company or Employer? If so, give

a. License classification and experience of pilot.

b. Number of flying hours credited to him.

c. Kind of terrain over which you will probably fly.

d. Type of ship and facilities for servicing it.

12. Enter here any additional information you care to submit.

Well, that is about all but you can draw your own conclusion as to the state of mind of the average person, who may have been in the air once or twice, when he has finished answering all these questions. At any rate I have never heard from that salesman again or from anyone else from his company. This one was followed by another who appeared to be more or less of an expert. He knew me by reputation and knew that I make an occasional trip by air. Instead of making out the usual application he filled out only the "passenger's aviation supplement" and told me that he would send that in with a letter, in which he would explain to the company the type of flying I do and how careful I am in regard to both equipment and piloting ability. After he had received an approval of me as a risk he would return with the formal application for my signature. Like the others, he has vanished into thin air so far as I know.

The next gentleman was brought in to me by one of my assistants and explained that he was not an insurance salesman in the usual sense of the word. I am inclined to agree with him for he told me frankly that he doubted my ability to obtain insurance at the regular rate although he was certain he could obtain it for me at an additional rate of about $15.00 per thousand. Even at that he did not appear to be interested in submitting my application to his own company but thought he could find another that would take it.

By this time I was getting a bit worried myself but managed to decline his offer, at the additional rate. I then asked him about accident insurance. He did not deal in this but knew a man who did and a couple of days later the two called on me. Yes, accident insurance could be obtained that

would cover me when traveling on regularly operated air lines between regularly established terminals, as a fare paying passenger.

The premium demanded on this policy was $75.00 per year and the face of the policy was to be $7,500.00 in case of a fatal accident, with lesser benefits in the event of certain specified injuries. I have since learned that this is a regular motorist's coverage and am informed that can be obtained by even a taxi driver except that the benefits, in his case, in the event of a fatal accident would have been $15,000.00. My suggestion that a rider be attached to the policy permitting me to fly in our own ship did not arouse any interest at first but when it became apparent that I would not deal on any other basis the matter was taken up with the home office and eventually the policy was issued. I remember that you laughed at me when I told you about it and told me how much better your own accident policy was.

For some reason the next salesman did not ask the question that leads to the "passenger's aviation supplement" and I did not mention it. The application was signed. A couple of days later the company doctor called on me for the medical examination and, for a few minutes I thought that all might be well. Not so. It seems that this company has that matter incorporated in the medical examination and it came up there. He completed his examination and left.

A couple of weeks later the representative of this company came in and laid a policy on my desk. An examination of it, however, revealed the fact that it had been written at an additional charge of $12.50 per thousand because of my aviation activities. I did not accept it and have heard nothing from the company since.

Several other salesmen arrived and departed, each with an application and questionnaire. When I say departed I mean just that, for they never came back. On one occasion I wrote two applications in one day, one salesman waiting in the reception room while I finished with another. I knew one of them pretty well and he listed my occupation as "Assistant Secretary" and said nothing about the detail of my work. It seems that this one nearly got by for I was examined by the company doctor and passed. At least I am told so. The matter then went up to one of the higher executives and here it hit the usual snag. He did not know me personally, but it seems that the papers on that particular day carried something regarding me and he remembered and associated the names. Result? Another policy issued but this one at a charge of $15.00 per thousand over the usual rate for my age. This policy was also declined by me although I am forced to confess that I had been on the pan so long that I thought the matter over for some time before I made that decision.

Last September another salesman called and explained that he had come at the suggestion of a friend of mine whose position, in connection with aviation, is similar to my own and who had been through about the same ordeal. This man did not represent an American company and his "passenger's aviation supplement" was a little different from the others. All he wanted to know was the average number of flights per year I had made. I made a check, as nearly as possible, of all my flights since the first one in 1911 and it averaged about three and a half per annum. You see, there was a period of about ten years when I did not make a flight of any kind. His company doctor examined me and passed me and he is the man who handed me the policy this morning. By the way, Chief, do you suppose I could get a little advance on my salary to pay for this one before someone over there reads the papers too?

Servicing Short Cuts

AVAILABLE TOOLS FOR INSPECTIONS

DAILY line inspections are one of the most important functions of any maintenance department. In the vast majority of cases they are carried out conscientiously and with the proper degree of technical skill. From a labor efficiency basis, they are rarely satisfactory.

A suggestion to eliminate much of the time and wasted effort, and to increase the quality and thoroughness, which is a function of the availability of proper tools, takes the form of an easily worked-out tool box, to be used only by the personnel intrusted with inspection work.

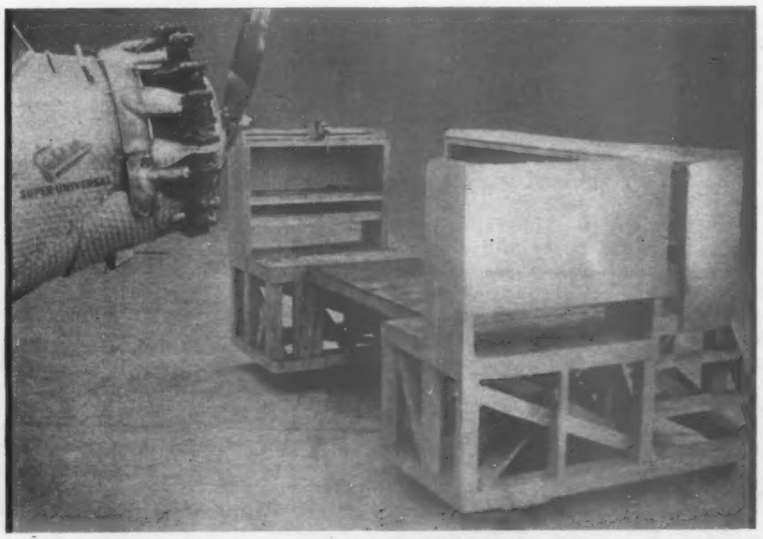
A portable carry-all copied after the usual carpenter's open saw and tool box is subdivided into a number of compartments and equipped with all the tools needed for thorough routine inspections.

In one small compartment are kept pliers, wire cutters, and a set of wrenches; in another, friction tape, safety wire, cotter pins, and an assortment of screws, nuts, bolts, and brads; in a third, a tire pressure gauge, a voltammeter, screw-drivers, etc. In a long compartment is kept a tire pump, zerk gun, alemite gun, and oil cans, and elsewhere room is made for log books, servicing records, etc.

Such a box need hardly be larger than 24 in. x 10 in. x 10 in. and when equipped with a wooden handle bar or a strap, can be easily carried from plane to plane. It can be cheaply built, and adapted to any specialized needs, and if properly utilized can easily save its cost including complete tool equipment in a short time. Painting the box and each of the items it contains, some distinguishing color will greatly increase its inviolability.

PLATFORMS IN THE SHOP

THE use of special stands and working ladders in airplane workshops has long been common practice. The development of such equipment as carried out by the Aero Corporation of



Platform for work on single-engined cabin planes

California under the direction of Mr. Walter A. Hamilton, seems to represent the ultimate in convenience and efficiency. The platform in question is nothing less than a small and complete shop built up several feet from the floor and mounted on castors. The floor space is ample to permit several men to work without interference. The platform is cut away to allow for the landing gear, and the height is sufficient to allow direct working on the engine, propeller, and engine installation. The benches, vises, shelves, and tools, with which the platform are equipped have been the means of effecting very appreciable time savings in such operations as top overhauls, cowling adjustments, etc., as well as increasing the general thoroughness and quality of the work. A workman up on a step ladder, who needs a tool he does not have with him, must choose between spending unproductive time in going after that tool or doing the job with the wrong tool. This complete shop platform removes both difficulties.

The accompanying photograph shows the type of platform used in working on single-engined cabin planes. Larger platforms of the same type have been just as successfully adapted to use with tri-engined aircraft.

GREASE HANDLING

CONSIDERABLE labor saving has been made in the service unit of Transcontinental and Western Air, Inc., at Alhambra, Cal., by equipping the grease storage barrels with a power pump for pumping grease into the tank of the Alemite pressure lubricator. This work is usually accomplished with a hand pump operated by a mechanic. In the Alhambra service unit a gear pump has been provided with the drive shaft extending above the top of the barrel. When a mechanic wishes to fill the Alemite electric lubricator, with which all of the planes are greased, he attaches a Black & Decker electric drill to the pump drive shaft, turns on the current, and quickly fills the portable tank.

Drawing grease by means of a pump driven by an electric drill

Technical Abstracts

CALCULATING WING RIB STRESS

THE DESIGN OF AIRPLANE WING RIBS, *By J. A. Newlin and George W. Trayer; N.A.C.A. Technical Report No. 345.*

DUE to their rigid joints and redundant members, the stresses in wing ribs are not ordinarily calculable, and the engineer confronted with the design of a new rib usually resorts to the trial-and-error method. In order to simplify the problem of rib design as far as possible, the Forest Products Laboratory undertook an investigation to determine some principles of broad application that would assist in the selection of the best general type of rib for a given airfoil and chord length, and aid in formulating rules regarding the effect of various factors on the design and strength of different parts.

The investigation included tests of wing ribs and of parallel-chord rib sections using various web designs—plywood, truss, and a combination of plywood and truss. The ribs had the airfoil section of the BS-1 lower wing, station 3, a rather thick wing section; both 48-in. and 96-in. chord lengths were tried. The parallel-chord specimens were 44 in. between centers of spar blocks, and had four different depths ranging from 3⅞ in. to 15½ in. The pressure distributions used in tests of the wing ribs were those recommended by the Bureau of Aeronautics, Navy Department. The load on the parallel-chord specimens was practically uniform.

Results of the tests were presented in the form of plots with the weights as abcissæ and breaking loads as ordinates. For each type a curve of maximum efficiency was drawn through the maximum values of strength-weight ratios. These curves represented the ideal ribs of various weights for each type and were the graphs of the equation $P = KW^{4/5}$, where P was the breaking load in pounds, W was the weight of the rib in ounces, and K was a constant dependent upon the type of construction. The value of K will vary with the chord and airfoil section, but the ideal ribs of any type for a given airfoil will have K's in the same relation as those found in the tests of the parallel-chord specimens, which were: 60 for the parallel-chord truss, 43 for the full webbed rib with stiffeners, and 40 for a rib with a full web and without stiffeners.

After manufacturing difficulties, limitations in service, and production facilities have been considered in the selection of a type, the detail design of the rib must be carried out. This report gives many suggestions on this subject, material having been gained from a study of hundreds of test failures. Some of the conclusions follow:

In a rigidly connected truss type of rib large secondary stresses often exceed the primary stresses. Wide members should be avoided. Secondary stresses may be reduced by putting a joint in the diagonal in the plane of the rib near the end fastening, or by reducing the cross-section of the member near its connection.

It is better to have compression diagonals adjacent to the spars, rather than tension, because of the difficulty in securing the ends of tension members.

When calculating the glued area required for the joints of truss members, a stress of one-fourth of that used for shear in the wood parallel to the grain should be used.

Double compression members with a spacer at the center were found to be about one-half as strong as the same members brought together and glued throughout their length when the length was such as to throw both in the Euler column class.

The coefficient of fixity for compression diagonals in a plane at right angles to the plane of the rib was found to be about one and one-half.

Nailing does not increase the strength of glued joints.

Members with thin, outstanding flanges and with little torsional rigidity, fail by twisting under loads much smaller than their calculated compression loads. This may be avoided by slightly modifying the cross-section without increasing the area.

Plywood with a balsa core was found to be satisfactory material for full webs, but if lightening holes were added the strength dropped rapidly because the balsa core tore apart very easily around the holes.

Small stiffeners glued near the edges of lightening holes were found very effective in reducing buckling; the small resulting percentage of increase in weight will often be accompanied by

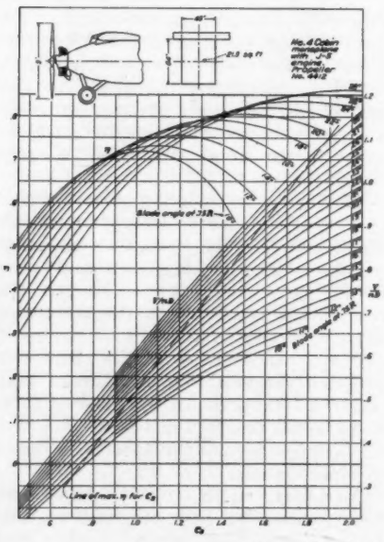
several times that percentage increase in strength.

Test results indicated that for full plywood, webs, greater strength was obtained with vertical face grain, but longitudinal face grain was stronger if lightening holes with stiffeners were added.

SELECTING METAL PROPELLERS

WORKING CHART FOR THE SELECTION OF ALUMINUM ALLOY PROPELLERS OF A STANDARD FORM TO OPERATE WITH VARIOUS AIRCRAFT ENGINES AND BODIES, *By Fred E. Weick; N.A.C.A. Technical Report No. 350.*

AERONAUTICAL engineers faced with the task of designing or selecting a propeller for a given combination of airplane, engine, velocity, and altitude have for years floundered through a routine analysis based on a combined inflow and blade element theory. Such procedure has been unsatisfactory from several standpoints: arbitrary assumptions were necessary at several points about which there was no general agreement; no proper allowance could be made for interference effect of different fuselage and cowling types; and last, but by no means least, the system



was a pragmatic failure, as often as not the resultant propeller was simply a first approximation and simply served as a point of departure for some cut and dried experimenting. A few of the more experienced designers were able, and usually preferred, to enter into such an experimental stage with recourse to the sketchiest of computations, relying on their own personal data for guidance.

This situation was further complicated by the advent of the adjustable pitch aluminum alloy propeller. Not only were new plan form, aspect ratio, and section factors required which made the necessary assumptions even more difficult, but the very feature of possible pitch change made any complete theoretical treatment hopeless.

N.A.C.A. Report No. 350 therefore is not only an extremely welcome addition to aeronautical design data but is very distinctly the mark of the beginning of a new era. An era of direct selection from charts based on full scale laboratory tests of geometrically similar propellers.

Working, of course, in the full scale propeller research tunnel at Langley Field, an exhaustive series of tests has been completed using a propeller of standard dimensions with various odd pitch settings and with various engine-fuselage combinations. The resulting faired and cross faired curves can be validly used for selection of diameter and pitch setting for any geometrically similar propeller, on any installation which approximates one of the following: (1) an open cockpit fuselage similar to the installation of the Curtiss D-12 engine with wing radiators, (2) a Ve-7 airplane with 180 hp. Wright E-2 with nose radiator, (3) an open cockpit fuselage with J-5 200 hp. engine with conventional cowling, (4) a cabin fuselage with J-5 with no engine cowling, (5) a cabin fuselage with large amount of conventional cowling, (6) a cabin monoplane with complete engine cowling.

The use of the charts can best be illustrated by the manipulation of a typical example. The one given in the report is for the selection of a propeller for an uncowled radial engine of 250 hp. at 1,700 r.p.m. mounted on a cabin-fuselage plane whose estimated top speed is 130 m.p.h.

(1) The performance coefficient $C_s = \sqrt[5]{\frac{\rho V^5}{Pn^2}}$ is computed for our case to be 1.40.

(2) Entering the chart it is found that an efficiency curve for a blade setting of 19 deg. will peak at our value of $C_s = 1.4$ and at 79.8 per cent propulsive efficiency.

(3) From the lower curves, for a blade angle of 19.0 deg. and a C_s of $1.4\frac{V}{nD} = 0.723$.

(4) V and n being known D is now found to be 9.31 ft.

A propeller, similar to the form tested, which is practically similar to the commercially available propellers of this type, should therefore have for our purpose a diameter of 9.31 ft. and a blade setting at 0.75 radius of 19.0 deg. and will yield us a net propulsive efficiency of 79.8 per cent, which completes our desired design data.

Procedure for any other performance or cowling conditions would of course have been similar although one of the other charts would have been used and different diameters and blade settings been indicated.

PLATING ON ALUMINUM

ELECTROPLATING ALUMINUM; *Published by the Aluminum Company of America, Pittsburgh, Pa.; 1930, 31 Pages.*

A TECHNICAL bulletin has been received recently from the Aluminum Company of America entitled "Electroplating Aluminum," which is described by a sub-title as "An Aid to the Practical Plater." It points out at the outset that when proper precautions are taken it is as easy to deposit certain metals electrochemically on aluminum as it is on almost any other base metal. After a brief discussion of the general properties of aluminum and aluminum alloys, the methods of cleaning and preparing for plating are described and the procedure is given for plating various metals on both smooth and roughened surfaces. Formulas are given for the preparation of cleaning compounds and the technique of plating is thoroughly described. Plating diagrams are appended covering the several alloys and their different forms. The booklet is illustrated by a series of photomicrographs showing the structure of various platings on aluminum, and a number of the forms which have been successfully plated are shown. The subject is of some interest in the aircraft field as one of the means employed to limit corrosion on certain small fittings and parts.

A STUDY OF AIRCRAFT WOOD

AIRCRAFT WOODS: THEIR PROPERTIES, SELECTION AND CHARACTERISTICS, *by L. J. Markwardt; N.A.C.A. Technical Report No. 354.*

FOR more than twelve years the Forest Products Laboratory, of the U. S. Department of Agriculture, has been studying the special requirements of woods for aircraft use, testing the mechanical properties of the more common varieties, and investigating possible new sources. The report under consideration is an excellent summary of their results and experience gained in all three fields.

Due to its variable nature, wood has always been handicapped for advanced structural purposes by a large factor of ignorance written into its allowable working stresses. By studying this variability and its causes, and reducing it through proper specification and inspection control, the Laboratory has rendered an exceptional service to the industry. This report carefully considers and explains the effect on the modulus of rupture of moisture content and specific gravity, and analyzes hundreds of test results, in arriving at a

complete table of physical properties for 27 of the commonly used varieties. This table is based on a moisture content of 15 per cent, and gives specific gravities and complete sets of allowable stresses. Each value is carefully modified from arithmetical averages, by considerations of probability curves plotted from their own data, and by factors to take account of the time the load is to be sustained (assumed to be three seconds for aircraft purposes). It is the latest set of working stresses adopted by the Army Air Service, the Navy Bureau, and the Department of Commerce.

There is a complete discussion of the effects of cross grain, and the defects which cause it and are limited by it. For example, knots and pitch pockets are permissible if they have not caused grain deviations beyond certain definite limits. Shakes and checks, mineral streaks, seasoning defects, decay and compression wood, are all discussed and practical limitations for rejections due to them are set forth.

Possibly the most interesting feature of the report is the detailed discussion of various species not generally used in aircraft, but which might be considered as possible sources of supply. There are 164 of these considered as to availability and general characteristics. A very complete table is included which compares the specific gravity, bending and compressive stress, hardness, shock resistance, and stiffness of each species, with the corresponding values for airplane spruce. A general weighted index of desirability on the same comparative basis is given with very suggestive results.

There are dozens of varieties which can now be considered in the class heretofore occupied by ash and a few other hard woods, and along with red, Sitka and white spruce for highly stressed parts, may now be grouped Alaska cedar, Port Orford cedar, southern cypress, Douglass fir, noble fir, western hemlock, northern white pine, Norway pine, sugar pine, western white pine, yellow poplar, and Engelmann spruce.

New Volumes for the Shelves

A COMPREHENSIVE YEAR BOOK

L'ANNÉE AÉRONAUTIQUE, 1929-30, *By L. Hirschauer and Charles Dollfus; Dunod, Paris; 451 pp.*

IN accordance with the rule of the last eleven years, this notable record arrives by the courtesy of the *Societé du Carburateur Zenith*. Although the burden of its distribution is presumably assumed for reasons not entirely unconnected with publicity, L'Année Aéronautique is as far as possible out of the class of publicity matter. Aside from a subdued working of the word "Zenith" into the decorative design of the title pages, there is no symptom of that company's interest except the inclusion of a brief appendix on carburetion in acrobatic flight.

A year book, purely factual and largely statistical, is a difficult volume to review at any length unless the compilers have been considerate enough to spot their work with errors to which the reviewer may point triumphantly by way of demonstrating his superior erudition. Messrs. Hirschauer and Dollfus have not done that. Even in writing of American events, notably hard for Continental Europeans to understand and interpret, they have been both singularly skillful in picking out the most notable points for treatment and in treating them accurately. Their volume, although intended almost solely for Continental readers, gives a full report of the Cleveland air races, the National Air Tour, the Guggenheim Safety Competition, and other important contests of the year, with a correspondingly thorough account of the happenings in all other parts of the world. For the man who wants a record of the aeronautical news at hand for reference the book is, like the ten that have preceded it in the series, invaluable.

As in past years, notable flights are carefully listed. Even more than in past years, they have been selected with a really extraordinary lack of national bias. Of the 25 flights recorded on a large map inserted in the book, eight were French, seven each of American and British nationality. I should be very much surprised if any list of great achievements published in America were to show so even a distribution and so little emphasis on home performances.

A similar freedom from nationalistic distortion is evident in the tabulation of the characteristics of the outstanding airplanes of the year. Of the 30 machines selected only twelve are French, nine American, and with one possible exception the group selected to represent the United States could not have been bettered. The reason for picking out the Lockheed Air Express as an airplane of 1929 is not apparent. That whole section of the book, however, is relatively unimportant, for the subject is so much better and more thoroughly covered in "All the World's Aircraft," which has the further advantage of being in English units instead of metric ones.

The British annual just mentioned also includes an outline of the aeronautical organization of each country and of the activities of the various government departments concerned, but L'Année Aéronautique does it better. The French system receives particular attention, but fifteen other countries are treated with laudable care. On the seven pages devoted to the United States, for example, hardly an adverse comment can be made except that there is a little vagueness about the internal organization of the Department of Commerce. Few Americans could give so clear and comprehensive a statement of how the government at Washington distributes its aeronautical functions.

The scope of commercial aviation is discussed, with appropriate statistics, for all the countries of the world. In preparing the statistical issues of AVIATION, L'Année Aéronautique has been found to have a higher batting average of completeness and accuracy than any other single source on foreign activities, and the new volume is in no way inferior to its predecessors.

There is more—a list of world's and French records, charts of 25 years' progress in record-making, brief reports of the most important aircraft shows of the year, and the like—and it all maintains the same high standard. Everyone who can read French, and whose interest in aeronautics extends beyond his own dooryard, ought to have a copy.

It is with a little sense of shame that I find myself compelled to give so high a rating to a French work of reference. We have in this country the yearbook of the Aeronautical Chamber of Commerce, and it is unequalled of its kind, but it is purely a record of the American industry. The inclusion of a foreign section is incidental. When we seek for a volume really international in outlook we have to choose between a French offering, a British, and a German one. American readers ought to have the right to expect such a book from an American hand and press, but its compiler and publisher have not yet proclaimed themselves.—EDWARD P. WARNER, *Editor of* AVIATION.

AIRPORT PROBLEMS

AIRPORT PROBLEMS OF AMERICAN CITIES, *By Austin F. Macdonald; Reprinted from Vol. 151 of The Annals of the American Academy of Political and Social Science, Philadelphia, Pa.; 60 pages.*

UNDER the above title, Prof. Austin F. MacDonald, University of California, presents an unusually inclusive discussion of this country's airport problem. Although in pamphlet form and comprising but 60 pages, it presents the

subject thoroughly and authoritatively.

In six chapters, the author covers such subjects as the relation between airport development and the Department of Commerce, a description of airports as they exist today, the problem of ownership and operation, the financial structure of airport interest, and what may be expected of the airports of tomorrow. This study does not attempt to sell any particular set of ideas, but presents leading representative opinions on all sides.—CHARLES H. GALE, *assistant editor of* AVIATION.

STRENGTH CALCULATIONS

HANDBOOK OF STRENGTH CALCULATIONS, *Air Publication 910; Air Ministry, London, 1930; 3s., 6d.*

THE British "Handbook of Strength Calculations," a book of some 120 pages of text, 50 pages of appendices and 71 pages of figures and tables, presents in a single volume a specification as to loading assumptions for airplanes, a treatise on the methods of analysis suitable for such structures, and a compendium of the physical properties and allowable stresses of a few of the common aircraft materials. A comparison with the 1924 handbook, a volume of some 110 pages, shows that the methods of structural analysis have changed but slightly during the intervening six years, but that advances have been made in aerodynamics.

Such advances are demonstrated, for instance, by the incorporation of values for center of pressure locations for common airfoils which discriminate between monoplanes and biplanes and provide for the forward movement of the center of pressure which has been noted in model and full-scale pressure distribution studies on biplanes. Chapter VIII, "The Aerodynamic Load Distribution on Tapered and Twisted Wings," and Chapter IX, "Calculation of Strength of Wings Fitted with Auxiliary Aerofoils at the Leading Edge," are new and describe rational methods for providing for the changes in loading over such portions of a wing as may be tapered, twisted or equipped with slots.

Chapter X, "Aerodynamic Performance and the Strength of Airscrews" is also new and, as its title suggests, concerns itself with the determination of the aerodynamic and strength characteristics of propellers. Both wood and metal propellers are considered.

The 1930 document presents in a clear manner the methods for determining the magnitudes and distributions of the loads to be provided for in the various design conditions. The specified conditions appear rational and well planned. They agree, for the most part, with methods and assumptions used by the regulatory agencies of other governments and they show a careful coordination with aerodynamic developments and an attempt to obtain design conditions which are in close accord with the conditions encountered by an airplane in flight. They are somewhat less arbitrary in some conditions, notably the nose dive condition, than are our American requirements, but whether there is any real advantage to be had from these apparently more precise conditions is a debatable point. In general, the presentation of the design conditions is excellent.

On the other hand, the presentation of the methods of structural analysis is felt to be unduly cumbersome and to be complicated by the incorporation of standard methods of analysis, the development of which does not seem fitting in a specification which is, in reality, what this handbook amounts to. To take only one item, the three-moment equation, we find it presented in the form usually given when axial loads are neglected, in Chapter II. In Chapter III, "Perry's Approximation" for the effect of axial loads on continuous beams is described and charts are provided for simplifying its application. In Chapter V we find the three-moment equation again, this time in terms of the areas under the primary moment curves. Further back in the book we find Appendices Ia, Ib, Ic, III, IV, V and VI concerned with the development and use of various three-moment equations, or modifications thereof, for the analysis of wing beams.

Most, if not all, of this information could well be deleted from a designer's handbook and presented in textbook form. Cluttering up a specification with descriptions of such conventional or routine procedures as are involved in the application of the various three-moment equations seems indefensible. Similarly, the explanation of methods for determining points of contraflexure on beams and of the standard analytical procedure for analyzing trusses may be mentioned as examples of data which must appear extraneous to the competent engineer. They cannot be justified on the ground that it is desirable to incorporate all design information in one volume, since one finds incomplete allowable stress data in this handbook. One must turn to other specifications to determine how much shear, for instance, is allowable on a beam, and it is still necessary to have a table of trigonometric functions at hand if one is to apply the "Berry Method," although some 12 pages are devoted to this method in Appendix Ia.

Taken as a whole, the 1930 "Handbook of Strength Calculations" appears to be well prepared, to be quite up to date and to fulfill its purpose in so far as it describes the magnitude and distribution of loads in the several excellent and well planned design conditions. It is unduly verbose and contains much data on stress analysis procedure that could be better presented in a complete and more logical manner elsewhere than in a specification, and it is incomplete, sadly incomplete, in so far as allowable stress data are concerned. One finds data on the strength of streamline, swaged and round wires, on cables and fittings. One finds data on rubber shock cord, on steel tubes as struts, on spruce struts of constant section and on the antiquated, but peculiarly British. straight-tapered and elliptically-tapered struts. Nothing is to be found concerning allowable stresses on spruce beams—nor on metal beams—on form factors in wooden members, on strength properties of the aluminum alloys, on the strength of welded tubes, on the difficulty of brazing nor on a number of processes or details that are peculiar to aeronautical structures and concerning which information is not readily obtainable.

As a handbook for designers, Air Publication 970 constitutes a very satisfactory specification for the design conditions, but it could be vastly improved by deleting descriptions of conventional methods of analysis and by amplifying the data on the properties of the more modern processes and materials which, in their application to aeronautical structures, are unique. — JOSEPH S. NEWELL, *professor of aeronautical engineering, M.I.T.*

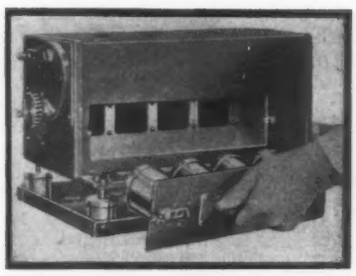
The Buyers' Log Book

RADIO RECEIVER

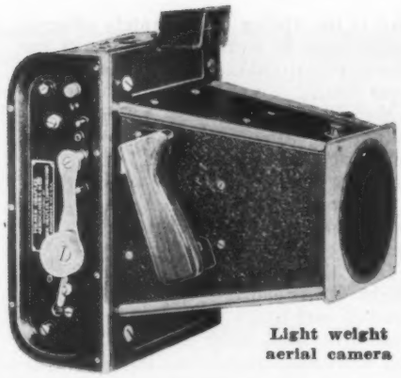
AFTER months of research and development work, the Aircraft Radio Corporation of Boonton, N. J., has perfected and is marketing a complete radio receiving unit for transport aircraft. Manufactured by the Stromberg-Carlson Company, the set includes a five tube receiver, six sets of interchangeable tuning coils, mounting base, battery and case, dynamotor, switch box, tuning control, together with the cable harness.

The source of power for this Model D receiver is the standard 12-volt airplane starting and lighting battery. Since the set requires current at pressures of 12 volts, 76 volts, and 144 volts a dynamotor is used to furnish the last two voltages in the standard set, although batteries can be used for all three if desired.

One of the special features of the receiver are the sets of coil combinations which are mounted as units and which



Complete radio receiving unit



Light weight aerial camera

Pioneer "straightway" compass

can be plugged in to give a selection of frequencies, six such coil groups cover a range from 235 kc. to 8,000 kc. Several operators are taking advantage of this feature and are using the set for tuning in on general broadcasts when it is not being used for more necessary work, individual headsets being furnished to passengers.

A remote tuning control, a switch-box which has a stand-by as well as on and off positions, and a cable harness with junction box, have been standardized and complete the equipment. Either low or high impedence earphones can be used in conjunction with the set.

The total weight of the standard installation with an average length of cable connections is about 52 lb.—AVIATION, *February, 1931.*

PIONEER COMPASS

THE Pioneer Instrument Company of Brooklyn has recently added a new improved compass to its line of aeronautical instruments. This new "straightway" compass incorporates design features intended to decrease the over-all weight of the instrument, reduce the period and overswing, and to add to the pilot's convenience in setting and following a given course.

Weight of the magnetic element has been materially reduced by eliminating the usual compass card and substituting a spider which supports magnets of special cobalt steel and carries two parallel bands marked with luminous radium material.

The bowl which is filled with the usual damping fluid is fitted with a rotatable glass-covered ring which can be locked into position by a thumb-lever on the side of the compass. A circular card with the cardinal points indicated by letters and the intermediate points by numerals is permanently fixed under the glass cover and rotates with it. Two parallel lines, which are radium illuminated and of the same width as the lines on the magnetic element, cross the center of the circular card in a north-south direction.

To steer a course with this compass, the top of the compass is turned until the desired bearing coincides with the lubber-line. The top ring is locked into place by the thumb lever and the course of the plane is changed until the two lines across the glass fall and are parallel with the two lines on the magnetic element. The plane is then on the desired bearing.—AVIATION, *February, 1931.*

AERIAL CAMERA

A LIGHT weight moderate priced camera for aerial work is now offered by the Folmer Graflex Corp. of Rochester, N. Y. This new camera the K-10 is designed for obliques and verticals from the air but is also equipped with a finite focusing mount which permits it to be used for ground shots, stops of 8, 10, 12, 15, 25, 50, 100 ft. and infinity being provided.

Using panchromatic roll film of 5x7 in. exposure size, the camera can be loaded in daylight and has a capacity of 25 exposures per roll.

The focal plane shutter has a speed range from 1/200 to 1/50 sec. while the anastigmat lens has a focal length of 10 in. f4.5 with a specially mounted iris diaphragm.

The weight, loaded, of the K-10 is but 22 lb. A field case, provided as extra equipment has a weight of 16 lb.—AVIATION, *February, 1931.*

What Our Readers Say

Instruments

TO THE EDITOR:

We have read with some interest Captain Frank Courtney's rather critical presentation of his views on the future of air navigation. Captain Courtney presents some rather novel aspects of our future air transport system, but speaks in a derogatory manner of most of our recent developments.

Quoting the Captain: "I contend that the airway lighting, the radio beacon and the telephone are no real aids to the serious development of navigation"; while reading further, we have "During a period of prolonged blind flying, a very frequent interchange of signals between ships and control bases will be necessary, and blind approach will be governed by radio beams or leader cable systems."

Just why our present communication methods and radio beacons are not a step in the right direction is not very clear.

We particularly take exception to the statement "that the compass situation on most American planes is very unsatisfactory", and that "the compass is apparently devised first to suit the plane, secondly to suit the pilot, and if any qualities remain, the compass can have them." Mr. Courtney also speaks of seeing "an atrocious installation such as the fitting of a compass behind a pilot with figures reversed and reflected with luck in a mirror, which is as often as not misted over and vibrating vigorously."

We feel that we are not exaggerating in saying that American aircraft compasses are at least the equal of those produced by any other country. The number of long distance flights successfully completed by their aid bears tribute to such a contention.

Regarding the reverse card installation, we are well aware of the shortcomings of such an arrangement. The only reason that such an installation is made is that somebody has built an airplane in which the disturbing magnetic influences are so bad that the compass cannot be placed in its normal position. The principle of a compass is well known; it takes its directive effort from the magnetic lines of force surrounding the earth. Unfortunately, the compass makes no distinction, and will respond just as readily to any other magnetic fields. If such a disturbing field be present in the airplane, there is no remedy but to move the compass to a better location.

Captain Courtney states that "the ordinary American turn indicator requires enormously excessive attention in rough air." Having produced these instruments for the last ten years, we feel

qualified to speak with authority on the subject. The present damping characteristic of turn indicators is the result of an investigation made in conjunction with the Army, the Navy and the leading commercial transport operators. As to indication by means of lights rather than a pointer, it would seem that a series of intermittently flashing lights would be much more disconcerting than the steady indication of a pointer, and the British, who have been using the flashing light form of indication, are in process of abandoning it.

In closing, we would like to add our word of praise for the work being done by the Department of Commerce and the Bureau of Standards. The lighting of airways and the development of the radio beacon system is a tremendous job, and the whole industry is appreciative of the Department's efforts.

GEORGE TATE, JR.
Engineering Service Department
Pioneer Instrument Company.

Design Prejudices

TO THE EDITOR:

I have read with interest your editorial entitled "Superstition in Airplane Design" in the August 1930 issue and I am pleased to advise of my complete agreement with the point of view taken which in my words is the following:

Each airplane and each part of such airplane should be considered by the designer with an entire open mind as to arrangement, type of construction and materials of construction in order to obviate any possibility of failing in the development because of entering the field in a prejudiced state of mind.

In short, generalizations are always dangerous, certainly so in Aviation. The principle "fifty million Frenchmen can't be wrong" applied to the British would show to the monoplane enthusiast that there may be some merit in certain instances for the bi-plane.

Incidentally, I personally feel that in general the predominance of such prejudiced opinion as exists maintains with pilots, publicists and financiers rather than with engineers.

T. P. WRIGHT,
Chief Engineer,
Curtiss Aeroplane & Motor Co., Inc

The Test Pilot

TO THE EDITOR:

Your editorial in the December issue titled "Test Piloting and Design" was read with interest and appreciation. Naturally I agree with everything you had to say on that topic and more particularly the value of the test pilot who is able and willing to report what he saw, felt and did and what the airplane did.

Turning over a few pages of the same issue, page 336, it seemed a coincidence to find Ralph Ofstie, himself an accomplished test pilot, stating that the one outstanding quality of a good test pilot is the ability to accurately observe and express in words an opinion of the behavior and characteristics of the airplane tested.

Many designers like myself have neither the time nor the ability to become accomplished flyers and must therefore depend upon the observations of a test pilot until such time as suitable flight recording instruments are generally available.

The then head of the N.A.C.A. Flight Test Department told me that some of our finest test pilots, including their own men, were surprised to find that instrumental records failed to support their statements and in some cases the test pilot's statements were flatly contradicted by recording instruments.

Some designers with whom I have talked on this point believe that the designer should not fly his own product as he understands too much about it and is apt to underestimate the importance of its eccentricities.

Designers frequently find that opinions and observations of two or more test pilots will not agree on the same airplane.

My own methods at present is to avoid preconceived interpretations of test pilots' reports and to have the ship tested by as many test pilots as possible.

My conception of a good test pilot is one who begins quite cautiously and experiments further as he becomes acquainted with the ship and continues to do so until he has thoroughly and completely investigated all of its characteristics and who, upon landing, is able to talk freely and accurately about what happened.

I recall a case in which Lieut. Steve Callaway was test flying a ship for us which had a tendency toward wing flutter in moderate dives. Steve could not discover the trouble accurately so I went along with him on the next flight and landed in the same puzzled state of mind he was. That evening I went out in the hangar and after a little investigation discovered that the lower aileron was rotating properly but the upper one was being bent by the interaileron strut before it had a chance to rotate. The aileron was of the long type and this barely noticeable bending of the upper aileron was causing the wing to flutter as we afterwards proved when the bending was eliminated. If Steve had not been such a good test pilot he would never have admitted that he was puzzled but would probably have reported, instead, some plausible-sounding cause for the flutter.

LESSITER C. MILBURN,
Vice-president, chief engineer
The Glenn L. Martin Company

Side Slips

BY ROBERT R. OSBORN

"GEORGE WIES, Roosevelt Field, N. Y., has purchased a Stearman powdered by Wright from the factory." Item in an aeronautical magazine.

Well, it may still be good for dusting.

Mr. T.A.K. sends us a clipping from the Akron *Beacon Journal* which may explain why one of our famous racing pilots isn't afraid of the pet he carried with him in his plane until recently "Turner was accompanied by Gilmore, his flying iron mascot."

We don't know just how to interpret the following clipping sent in by R.H.D., Jr., of Farmingdale, N. Y., but we must say that the whole affair looks very suspicious to us, Dr. Watson, very suspicious. The clipping is from a news bulletin put out by a contemporary magazine, and states: "Olinger Mortuary, Denver, Colo., has established a commercial air taxi service."

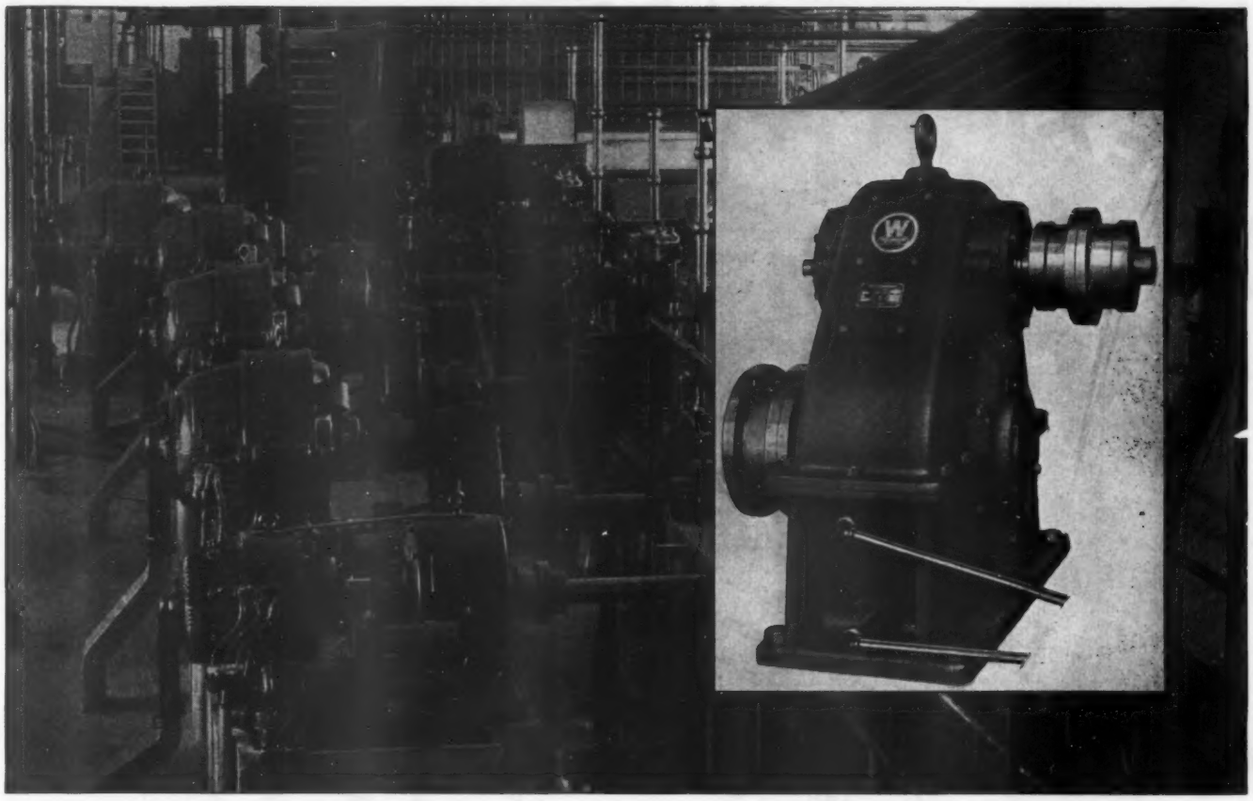
The report of the test of a new muffler in the New York papers is very interesting: "Reid taxied along the field with the throttle wide open, but onlookers failed to hear the usual roar of the exhaust and the only loud report was the scrape of a piston." The amazing part, to us, is that the scrape of the piston didn't bring a roar or at least a loud report from the pilot.

The New Haven *Evening Register* makes a very serious charge against the Colonial Air Lines in a recent issue and we suggest that the Department of Commerce investigate the whole affair. A Colonial plane recently made a forced landing at Wallingford, Conn., because of weather, and the *Register* reports: "In response to the signal flares calling it to safe shelter the big plane gave the air minded boroughites a thrill as it glided over the borough twice before landing at a very low altitude."

What we wish to know is, just what is the idea of landing at a low altitude? (Item discovered by "The Flying Nutmeg" our Bridgeport attention caller.)

The other day we ran across a two-year old aeronautical magazine, and noticed the inevitable advertisement of the flying school: "Are you hungry for..adventure..popularity..big pay? Then choose aviation!"

Revising this advertisement to fit modern conditions "Are you hungry?.. Then you're in aviation!"



These Timken Bearings Have Run 70 Times the Life of the Average Automobile

The pinion bearings in the 6 Westinghouse-Nuttall gear reduction units at the Washington Pulp and Paper Company have each rolled up the enormous total of over 2,338,000,000 revolutions, and a recent check-up shows that they are good for many millions more.

Loaded 100% of their Timken catalogue rating, they have averaged 6¼ days per week, 24 hours a day since they were installed in April, 1923.

The total distance traveled by each of these bearings is the equivalent of driving an automobile more than 3,500,000 miles, whereas the average automobile travels but 50,000 miles during its entire life.

A worthy tribute to Timken stamina! Don't you want this same unequalled endurance in *your* ships? The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* BEARINGS

TEXACO MARFAK GREASE
ENDURINGLY
EFFECTIVE
HERE'S the lubricant that has solved the problem of rocker-arm lubrication. Its lasting qualities, resistance to high temperatures and highly effective lubricating qualities are exceptional. It has proved ideal for the lubrication of rocker-arm assemblies and all enclosed grease-packed bearings.
Prominent flyers and engine manufacturers who have tested it—in the air and in the shop and laboratory—find it admirably suited for this especially difficult job.
Texaco Marfak Grease, and the well-known Texaco Aviation Gasoline and Texaco Airplane Oils are available at the leading airports of the country.
THE TEXAS COMPANY
135 East 42nd Street, New York City
TEXACO
REG. U.S. PAT. OFF.
TEXACO
MARFAK GREASE
TEXACO

TEXACO AVIATION GASOLINE • TEXACO AIRPLANE OILS • TEXACO MARFAK GREASE

SHIPS THAT FIT EVERY FLIER'S NEED

PRICED TO PLEASE ALL-COMERS TO THE SKIES

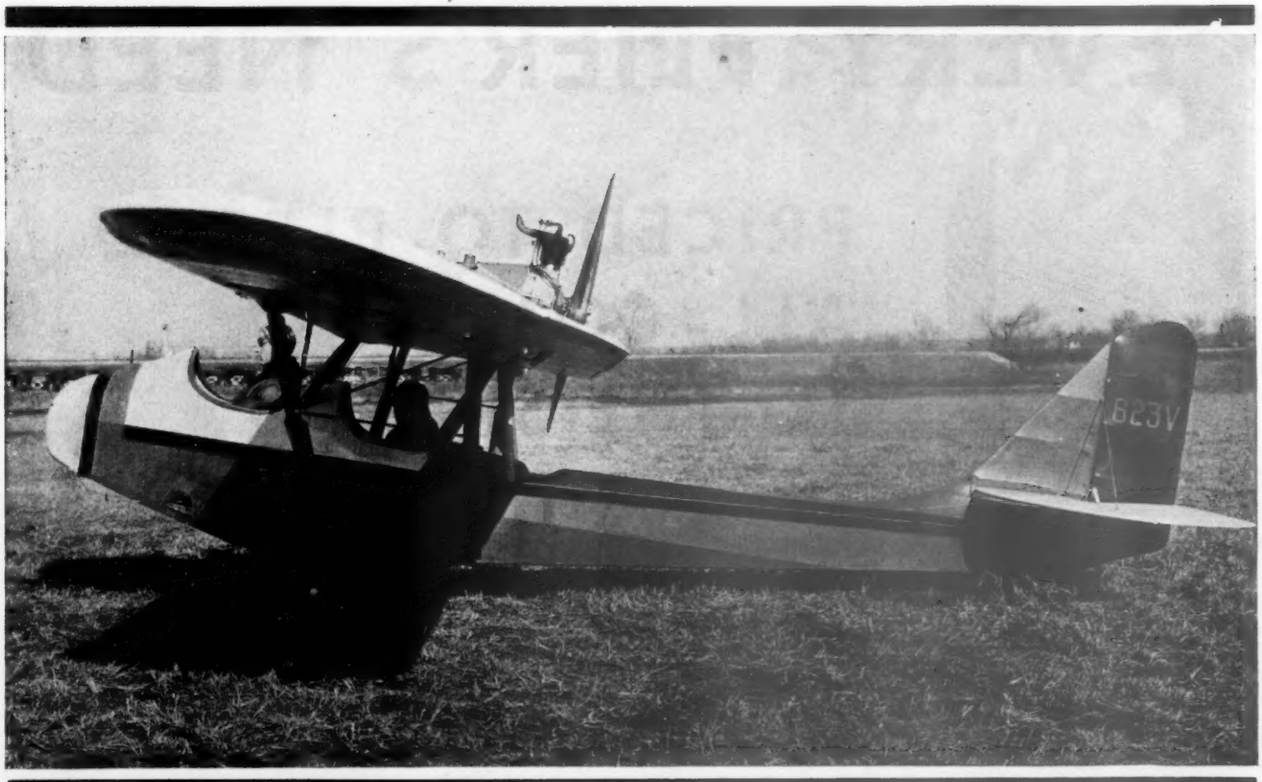
CURTISS-WRIGHT will present a fleet of seven ships for 1931 that will perform feats of endurance, economy and handling ease that set up new standards of simplicity and service. ● Trim refinements, abundant power give the new Curtiss-Wright runabouts announced here . . . and the other ships to be announced soon . . . a measure of performance and rugged strength that will please owners of 1931! ● Here is your opportunity to get your share of the business now and in the years ahead. Striking simplicity of control and of service makes it possible for anyone to own or pilot a Curtiss-Wright plane. Wide variety of the well-balanced fleet gives dominance to the dealers of Curtiss-Wright in every field of flying. ● For here are seven outstanding new ships. They're priced to please all types of buyers. They're designed to suit every kind of need. They're produced by the oldest and best-known manufacturer. And they're distributed by the best dealer organization. ● To the public Curtiss-Wright means dependable flying. To pilots it means stamina and service. To the distributor, building good business now and for the future, Curtiss-Wright is a name he can depend on . . . a name to help him grow!

CURTISS-WRIGHT

AIRPLANE COMPANY

ROBERTSON, MISSOURI

NOT ONLY A NEW PLANE BUT A NEW KIND OF PLANE!



THE CURTISS-WRIGHT "JUNIOR"

THOSE who are flying ships two years old have no idea what keen work has gone on behind the scenes in research and engineering. ● As you look over these advance models of Curtiss-Wright's new fleet you cannot fail to be impressed with the striking strides of Curtiss-Wright production. ● But of all the fleet, the ship that will supply the most news for 1931 is the Curtiss-Wright "Junior"—a 2-place plane specially designed for amateurs! ● Engineered by the staff that designed fighters for the Army, the Navy, and record-smashing sport and commercial planes, the "Junior" benefits by all that Curtiss-Wright has learned in building for the whole field. ● First, imagine a ship that costs $1490 . . . one that takes off from a good-sized lawn, lands in the same space, and is so easy to fly that beginners have mastered it in a day! ● Imagine a plane that hits 80, cruises at 70 . . . gets 26 miles to a gallon of gas . . . yet lands at 28 m. p. h. in 150 feet! For that's what the "Junior" will do! Easy to buy, easy to fly...and so refined in design that an amateur could assemble it. ● Instruments complete even to a Beech-type speed indicator and perfect visibility makes it the easiest type to fly or to learn to fly. Such refinements are possible only when an organization designs its products to cover the entire field.

STABLE FOR SPORT
STURDY FOR TRAINING

THE TRAVEL AIR
"SPORT-TRAINER"

WHAT Curtiss-Wright learned from the "Mystery Ship," fastest commercial plane in the world, Curtiss-Wright now incorporates in the striking new TRAVEL AIR Sport-Trainer. ● Sturdily built, trimly refined, you'll like this fleet little ship. It offers advances in stability, handling and servicing ease, which can be effected only when an organization builds for the whole field. ● Its clean-cut lines, its sleek streamlining, its speed in excess of 100 m. p. h. and cruising range of 500 miles, make it a craft of which you may be justly proud. ● Actually it's so stable in flight and so responsive to all controls that it's a real treat to fly it! ● Powered with the air-cooled Wright-Gipsy engine, with a full complement of quality instruments, with a special wide-tread, shock-absorbing landing gear and brakes, this TRAVEL AIR is remarkably easy to control on the ground or in the air. In every detail it is designed to make flying and servicing by the owner as inexpensive as possible. ● That's why the Sport-Trainer will make a wide appeal to 1931 buyers!

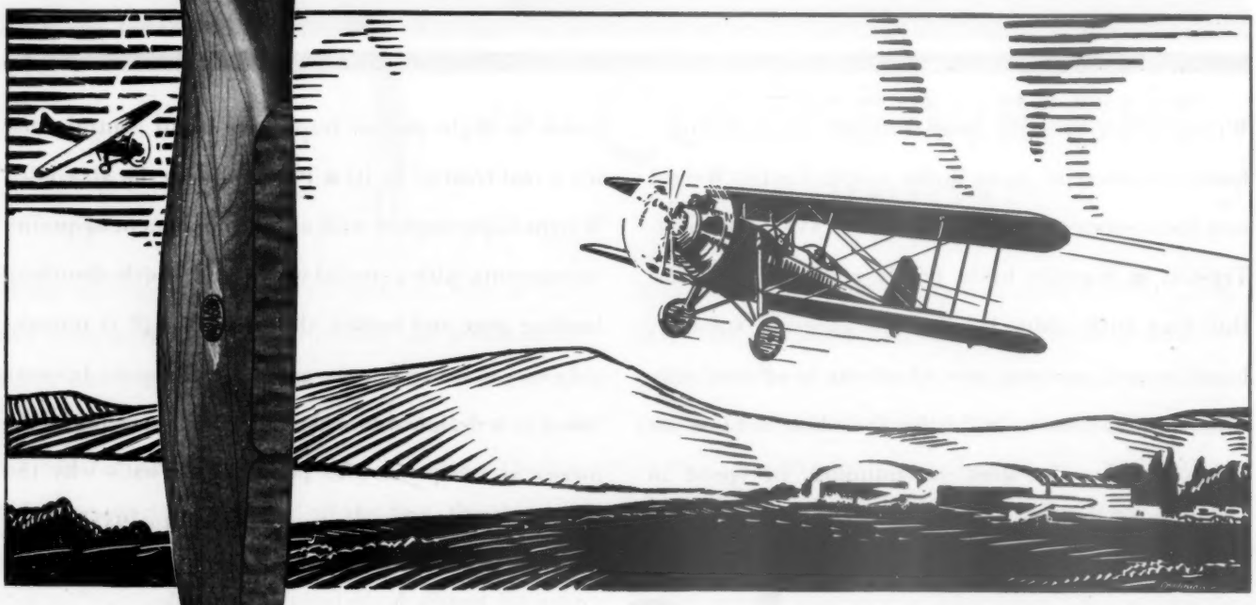
CURTISS-WRIGHT
AIRPLANE COMPANY
ROBERTSON, MISSOURI

Use wood propellers— for LIGHTEST WEIGHT *for* LOWEST COST—

Satisfaction and economy are built into the sturdy laminations of every Paragon Propeller.

Design is correct—based on broadest experience. Materials, workmanship are right; we know —we control them.

For smaller ships selling at popular prices, and for larger ships using geared engines, consult with us about Paragon's standardized models.



PARAGON

AMERICAN PROPELLER COMPANY

(Division of Bendix Aviation Corporation)

SOUTH BEND, INDIANA

DISPATCHING MAIL AND PASSENGER PLANES BY

TELEPHONE TYPEWRITERS

IN THE efficient operation of air transport lines, quick, accurate and flexible communication is a basic need. The Bell System meets this need with Telephone Typewriter Service*—a modern form of communication which provides an unlimited flow of typewritten messages between all connected points.

Eastern Air Transport, Inc., uses Telephone Typewriter Service to connect thirteen of its airports and offices from Brooklyn to Jacksonville. The circuit is used for dispatching mail and passenger planes, reporting plane movements, transmitting weather information, making passenger reservations, and exchanging passenger lists.

Officials at various points can confer almost as readily as though they were in the same room. The handling of mail is facilitated, because of the quick and complete information transmitted about the number of pouches carried by each plane, their poundage and destination. Accounting details are speedily handled.

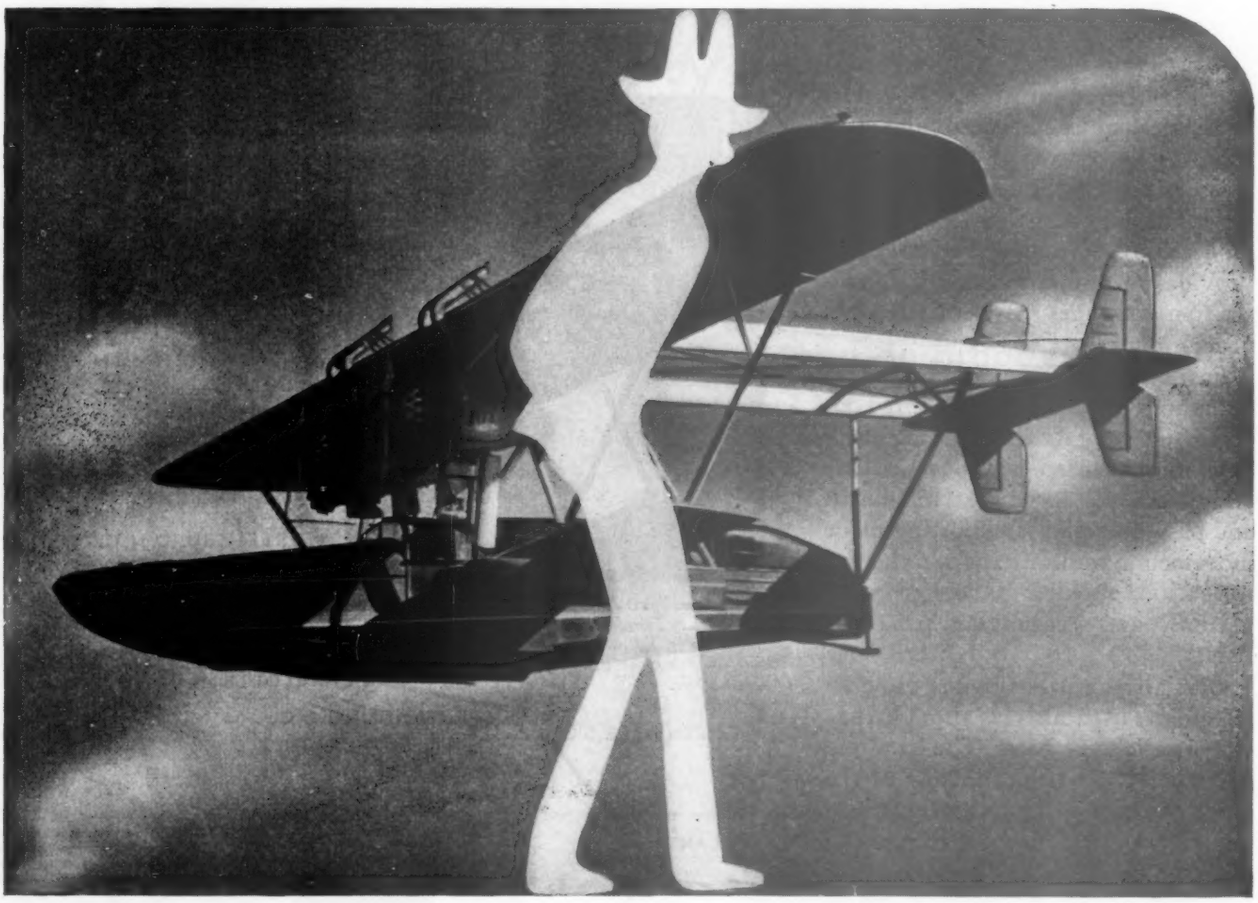
Other air transport companies also use Telephone Typewriter Service. Manufacturing concerns direct the activities of distant factories and branch offices. Your local Bell Company will gladly help you make a survey to determine whether Telephone Typewriter Service could be of similar value to your company.

* * *

**Telephone Typewriter Service combines the speed of the telephone, the flexibility of conversation and the accuracy and permanence of the typewriter. A message typed in one office is reproduced at the same moment in identical typewritten form in all connected offices. Telephone Typewriters can be operated by any one who can operate a typewriter.*

Airports and offices of Eastern Air Transport from New York to Florida keep in constant touch with each other by Telephone Typewriter Service. Any unit can "talk" in written form directly to any or all others.

YOU'RE A TOTAL LOSS TO A PLANE, MR. WATER-THIN, THAT'S WHY QUAKER STATE THROWS YOU OUT!



MR. WATER-THIN is the worst of loafers. He never did a tap of work in his life. For he's the quart of thin, non-lubricating oil that ordinary refining leaves in every gallon of aero oil. Material that's so light-bodied that Quaker State engineers call it "water-thin"—and throw it out!

Ordinary refining can't remove "water-thin". But Quaker State refining can and does get it out. It gets it out by an *exclusive* special process. And by removing "water-thin", Quaker State is able to replace this waste with rich, full-bodied lubricant. Quaker State gives you four full quarts of lubricant to the gallon instead of three quarts and one quart of waste. So Quaker State really gives you an *extra quart!*

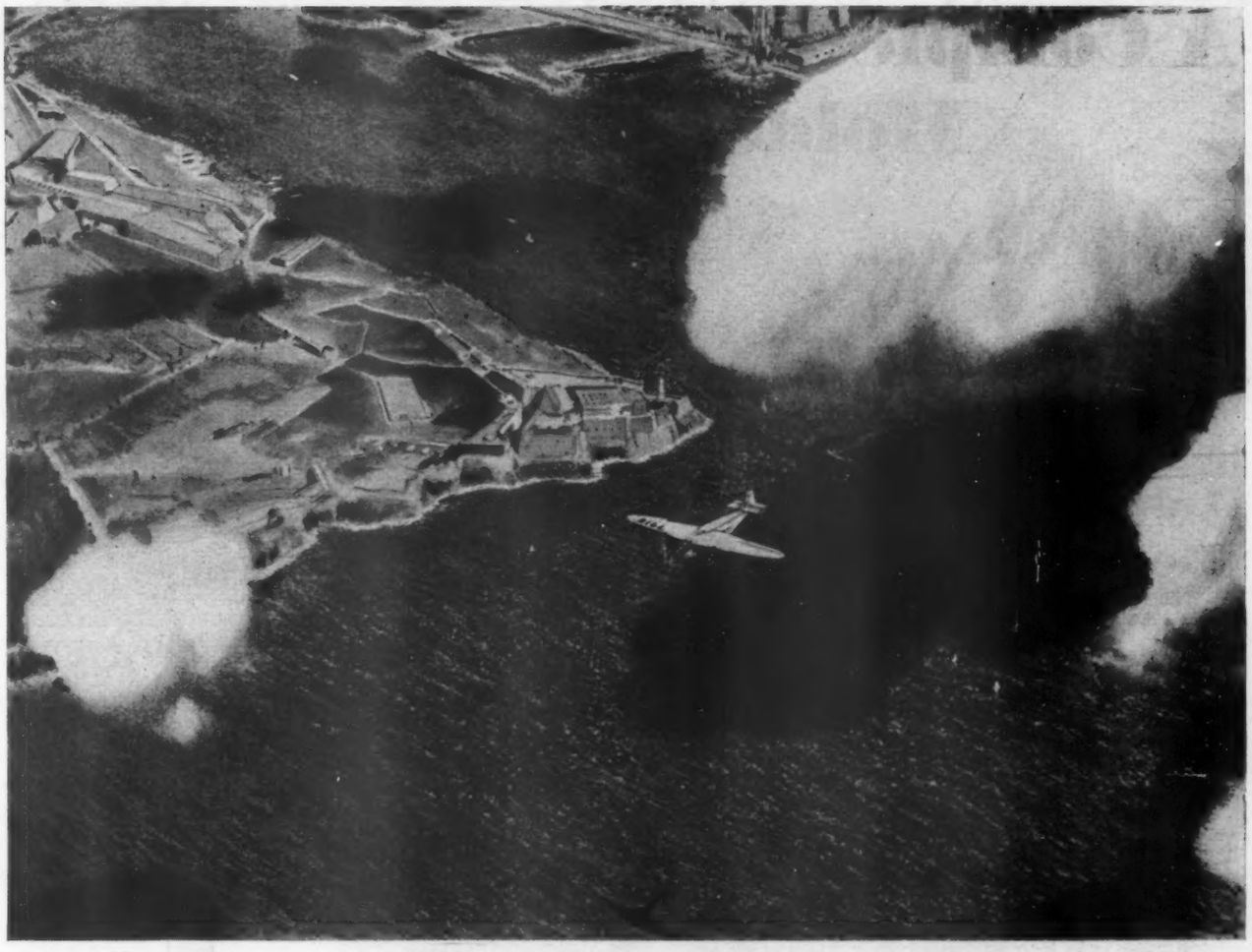
It took years of refining experience and skill to work out the process that removes "water-thin". It took an enormous investment in equipment to put it into operation. But the result is more than worth it. For it has enabled Quaker State to produce the best lubricant an airplane ever had. It is the chief reason why Quaker State is the world's largest selling pure Pennsylvania Oil!

And here's still another reason why Quaker State gives better lubrication. Quaker State is made entirely from 100% pure Pennsylvania Grade Crude Oil,—a motor oil so free from impurities that it doesn't require acid treatment in refining. That's important! For acids tend to destroy some of the oil's oiliness.

Try Quaker State. Let it prove its case against any aero oil you have ever used. It will! For there's a full quart of extra lubrication, extra protection in every gallon of it!

QUAKER STATE
TRADE-MARKS REG. U.S. PAT. OFF.
MOTOR OIL

THERE'S AN
EXTRA QUART
OF LUBRICATION
IN EVERY GALLON



WE FLY...

YOU know the sudden breath-taking sense of exaltation when your car emerges on the crest of some magnificent headland from which you look for miles out to sea or over billowing rows of mountains below. What is that sensation? It is a sudden sense of power . . . a feeling that your human faculties have been miraculously extended . . . it is a slight taste of divinity!

How immeasurably greater this sense of divine exaltation is when gliding high in the heavens, looking serenely down upon the colorful, silent world below! It is a feeling known only to those who have learned from personal experience the tranquil glory of flight.

Those who know the freedom of the airways find in the old paths of earth something nerve-wracking . . . a sense of restraint, of suffocation almost . . . much as the pioneer motorists looked back on the days when they sat in clouds of dust behind plodding teams of horses. Each month they find increasing pleasure in the pathways of the sky . . . slipping down to bright Havana, to Panama or Peru.

Unless you are too old to readjust your habits to new aspects of life, some day you will fly. Fortunate are those men and women who today recognize that the realm of the skies is offering a fresh lease on life. The blithe spirit of a new renaissance is in the air. It is hard for those who feel it to interpret its significance, though we see the faces of men turning upward, and we see the far places of the earth brought nearer in friendly communication.

The great tri-motored, all-metal planes of 1931 are truly yachts that bring you safety not only as sure as the safety of your yachts upon the sea, but as luxurious and as restful. These new planes free your thoughts from mechanical limitations, just as you are today above the concerns of the engine-room of a steamship.

The pilot and mechanic in their forward control cabin have every mechanical device necessary for day or night flying in all seasons. Fundamentally the new plane is designed as close to mechanical perfection as possible, with all the strength and extraordinary performance ability for which Ford planes are famous. Beautiful as a jewel, it spreads its wings like burnished silver, to fly with the smooth grace of an albatross over sea, over land, over deserts or arctic wastes.

• FORD MOTOR COMPANY •

A Complete Line of Textolite Molded Control Pulleys

with Sleeve Bearings and—

with Ball Bearings

EVERY Textolite control pulley is accurately molded around its bearing; this assures uniformly high quality and makes the bearing an integral part of the pulley. Even the cable groove is molded; there is no machining of the surfaces to expose the fabric and cause deterioration.

These Textolite pulleys conform to Army-Navy specifications and are approved by the United States Department of Commerce. They are not affected by moisture, gasoline, oil, salt spray, or weak acids. Ask for complete information. General Electric Company, Schenectady, N. Y.

Textolite molded control pulleys combine the experience and technique acquired through the production of more than half a billion moldings.

700-6

GENERAL ELECTRIC

JOIN US IN THE GENERAL ELECTRIC PROGRAM, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

NOW THAT THE NEWS IS OUT

we can tell this one about the new

AIRWHEEL BRAKE

We call this brake new because it was first announced in print last month.

As a matter of fact, like anything Goodyear builds, it was under test for close to a year.

Back in 1930, at the time of the National Air Tour, two Wacos were equipped with this brake, as well as with Goodyear Airwheels.

When the tests were run and ratings established at Ford Airport prior to the Tour, *these two Wacos made by far the best stick and unstick time of all competing planes.*

That one fact tells a bookful about the *power*, the *smoothness* and the *sure, quick release* which make pilots call this latest Goodyear development the greatest brake ever put on an airplane.

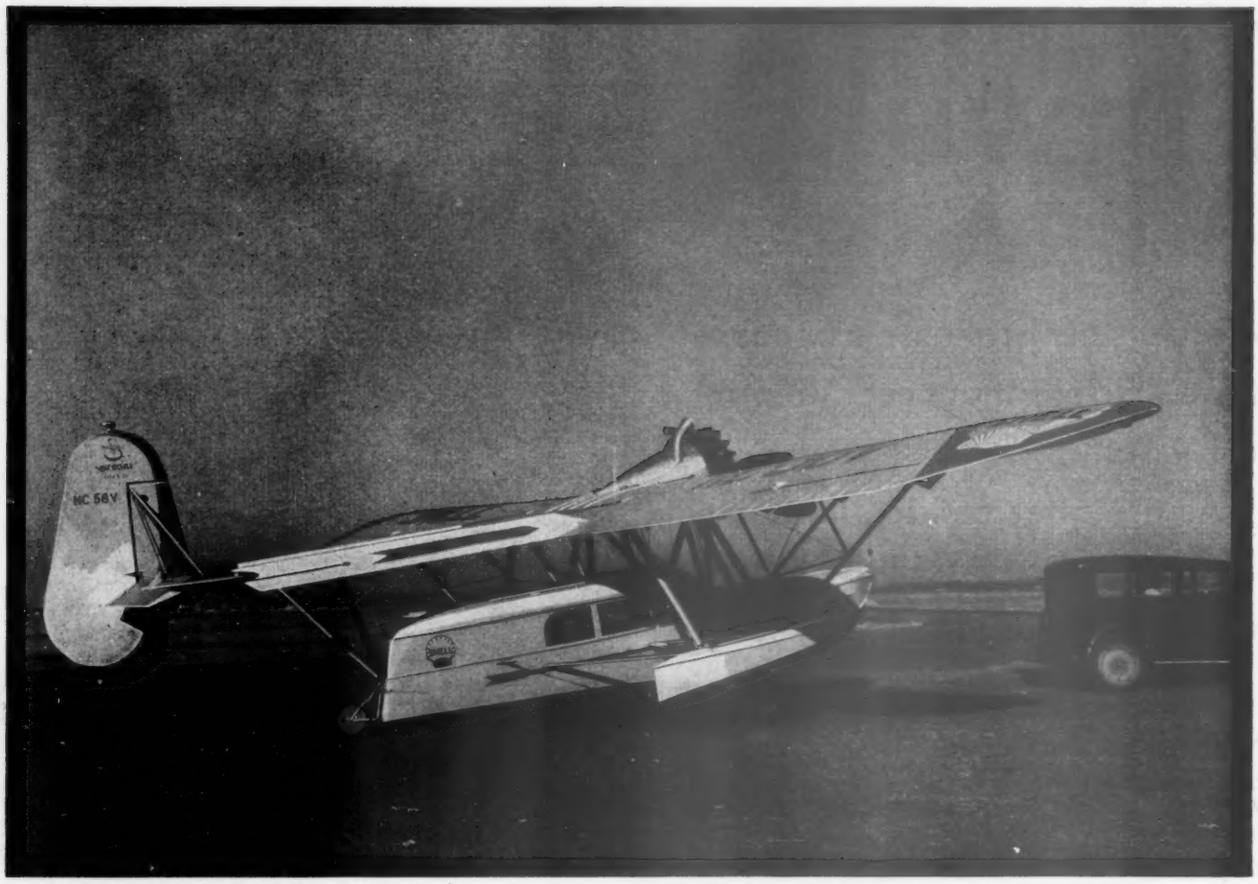
If you're interested in safe flying, find out the whole story. Write or wire to Aeronautics Department, Goodyear, Akron, Ohio, or Los Angeles, California.

WHEN YOU BUY A NEW SHIP SPECIFY GOODYEAR AIRWHEELS

GOODYEAR

EVERYTHING IN RUBBER FOR THE AIRPLANE

FOR EXECUTIVE TRANSPORT



SHELL OIL PICKS A SIKORSKY "S-39"

With important business connections at points spotted all over the map, the Aviation Department of Shell Eastern Petroleum Products has a keen interest in cutting down travel time. Like many other leading commercial and industrial organizations they find that the shortest distance between two points is often the straight line flown by their Sikorsky S-39 Amphibion. Particularly when one point is on water and the other is on land.

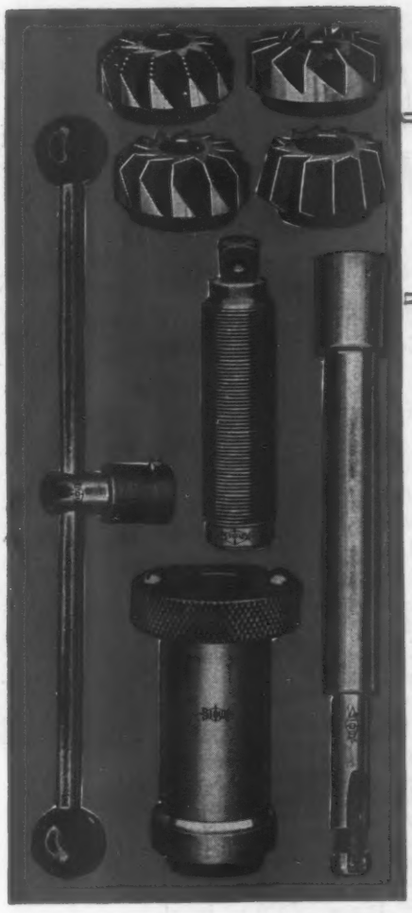
Travel time saved in a Sikorsky S-39 is never done at the expense of comfort. Five persons find luxurious ease in the cabin. Taxiing ashore or afloat, the amphibion handles superbly. Clever hull lines, plenty of rudder surface — and a steerable tail wheel give the plane handling qualities on water which are usually obtained only with two or more engines. A 300 H. P. Wasp Engine gives the S-39 a speed of 119 miles per hour and her ceiling is 18,000 feet.

Other Sikorsky Amphibion types are the 10 place S-38; the S-41 which carries sixteen and the 40 passenger S-40. For information on any of these models, address Sikorsky Aviation Corporation, Bridgeport, Connecticut. Division of United Aircraft and Transport Corporation.

WORLD'S RECORD FOR SPEED WITH LOAD

SIKORSKY AMPHIBION

WORLD'S RECORD FOR ALTITUDE WITH LOAD



STANDARD THE SIOUX WORLD OVER

VALVE SEAT REAMERS for AEROPLANE MOTORS

Made for Precision Work

THE Sioux System of refacing valve seats in aeroplane motors makes it possible to obtain great accuracy with comparative ease and speed. The Sioux Aeroplane Reamer Set includes Sioux Pilot Stems, Feed Screw, Feed Screw Body, T Socket Handle, L. H. Aeroplane Reamers and Hammer.

The feed screw body has a spring within the feed, so that when the feed is screwed up it brings the reamer against the valve seat. The tension of the spring in connection with the feed keeps the reamer teeth beneath the surface of the metal. This adds much to the life of the reamer,—prevents the reamer from sliding over the glazed surface and thus avoids removing the cutting edge. The No. 1640 Feed Body is universal, so constructed that it automatically adjusts itself to every individual motor.

A cleverly designed pawl within the feed screw interlocks with a pawl on the pilot and thus eliminates the use of pins, set screws or threaded connections. Easily and quickly assembled.

Sioux Aeroplane Reamers are made of a special alloy tool steel which stands up and holds its cutting edge in the severe work of cutting the bronze valve seats used on most aeroplane motors. They are also made left handed so the tool can be turned to the right. Cutting resistance has been reduced by eliminating some of the cutting edges. Made in 45° finishing and roughing, 15° narrowing in finishing type and 75° narrowing in finishing type.

No. 1650 Sioux Aeroplane Reamer Set. Net, Complete **$64.25**

Your Jobber Sells Them

ALBERTSON & CO. INC.
SIOUX CITY, IOWA. U.S.A.

CITY HAILED AS KEY IN NAVY AIR GROWTH

League Island Factory and Facilities Here Praised by Commander Weyerbacher

CIVIC CHIEFS FETE OFFICER

"Results over more than a decade have vindicated the Navy's choice of Philadelphia as the ideal labor market and the best location for materials for the development and manufacture of naval aircraft," Commander Ralph D. Weyerbacher said yesterday.

Commander Weyerbacher, for years head of the Naval Aircraft Factory at League Island, and now assigned to Washington as head of the materials division of the aircraft division of the United States Navy, was speaking at a luncheon tendered him by the Aviation Committee of the Philadelphia Chamber of Commerce, of which he has been a member.

"The League Island plant, erected after a careful survey by the Navy Department of the whole Atlantic coast, is now regarded as the great experimental workshop for American aviation," he said, "and the Government is determined that its needs in this field shall be filled by this city's industries.

"At present the plant at League Island has 1160 employes and virtually no labor turnover, for we have been able to develop a constant workload and, by working economically and efficiently, are steadily decreasing our costs.

"It is worthy of note that of the men trained in that factory who have gone out into the other aviation fields all have been highly successful.

"One of the principal projects has been the development of the metal flying boat, which has gone forward steadily and speedily.

"Philadelphia has wonderful metal producing plants which could turn out all necessary materials, so that in time of stress the Naval Aircraft Factory could become a vast [illegible] plant with [illegible]

Reprinted from Public Ledger Dec. 24, 1930

"Actual experience is the best proof." Commander Weyerbacher's statement gives but part of Philadelphia's advantages, not only applying to aircraft manufacturing but to other industries as well.

Specific reports applying to your needs will be prepared by our Technical Staff if you request them on your own business stationery. Address Department B. C.

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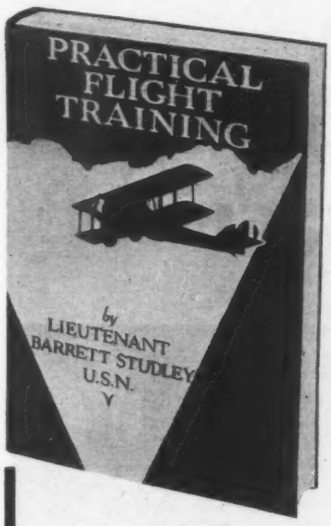
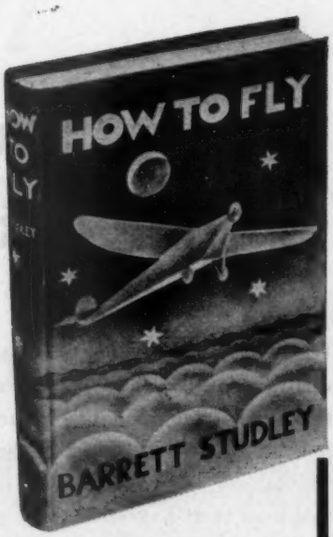
Business Progress Association

1442 Widener Building, Philadelphia



You can double the value of your time in the air by studying these two authoritative books on flying . . . . . .



by

LIEUTENANT BARRETT STUDLEY, U. S. Navy

Chief Flight Instructor, Naval Air Station, Pensacola, Fla.

No matter where you are learning to fly, PRACTICAL FLIGHT TRAINING and HOW TO FLY will save you time, cut the cost of your hours in the air, and above all teach you the fundamentals of flying *safely*. The man who has studied the maneuvers of flying on the ground is the man who learns them most quickly in the air. He knows precisely what he is trying to do. Therefore, he gets full value from every minute of instruction.

These two books give you the same course of instruction that student pilots at Pensacola receive in their training. You will actually learn to fly with a crack Navy pilot! Lieutenant Studley has had ten years' experience as a Naval aviator. He is familiar with all type of planes, both landplanes and seaplanes, from slow training craft to fast single-seaters and big multi-motored bombers. He knows Navy standards and how to train students to meet their rigid requirements. In these books you get the same instruction that he gives his own students—sound, understandable, practical and authoritative.

PRACTICAL FLIGHT TRAINING
A Technical Book for the Flight School Student

This book is written for the man who is ready to begin flying. It contains everything which an experienced instructor will tell him about the actual handling of the controls in the air.

Some of the chapters cover: Aerodynamical principles of flight—Personal qualifications for flying—Courses of instruction — Safety precautions — Taxying — Take-offs — Control movements in the air—Turns, including slips, skids and how to avoid them—Spirals—Landings—Tail spins and how to keep out of them—Stunts—Cross-country flying—Forced landings and how to make them safely—Aerial navigation—The pilot's license.

Both landplanes and seaplanes are included in all chapters.

The only book of its size devoted entirely to the actual handling of an airplane in the air.

435 pages **160 illustrations** **Price $5.00**

HOW TO FLY
A Popular Book for Every One Interested in Aviation

This book covers the same field as PRACTICAL FLIGHT TRAINING. The fundamental principles of flying and its most important practical problems are fully explained. But it is written in less detailed form. All maneuvers are described in simple, non-technical terms which anyone can understand.

The most interesting book yet written on practical flying.

291 pages **66 illustrations** **Price $3.00**

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Please send me C. O. D., plus postage, the book (or books) I have checked below. If I am not satisfied and return it (or them) within five days, it is agreed that the purchase price will be refunded.

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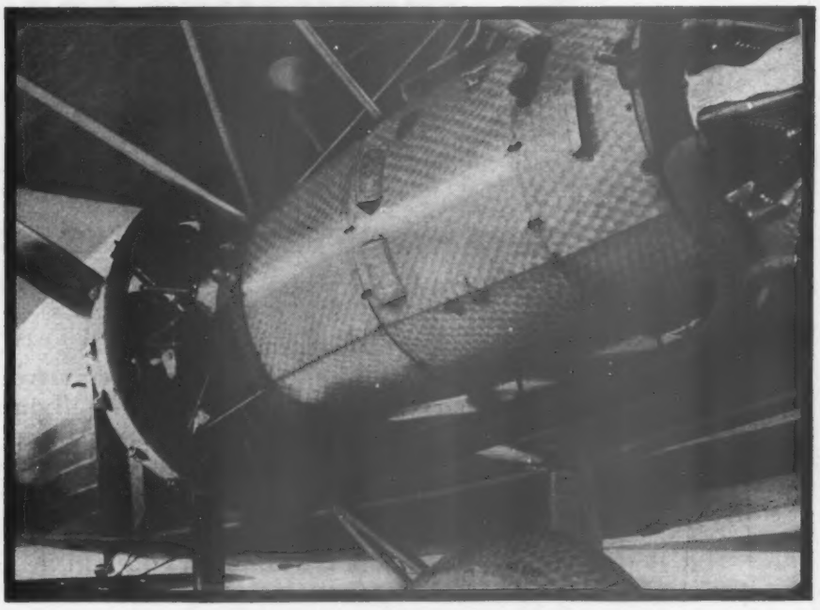
Town ..... **State** .....

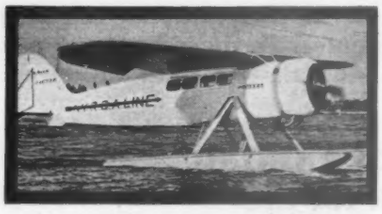
NEW LAURELS OF DEPENDABILITY for SERIES B "HORNET" ENGINE

IN a little over a year of exacting military and commercial service the Series B "Hornet" engine has proved itself a worthy brother of the famous "Wasp." Speed, altitude and load tests have recorded its reliability. Mail and passenger carrying with the great air transport companies have shown how well this engine stands up under day and night service. And now, new laurels:

In what was probably the most strenuous 300-hour test ever made upon an air-cooled radial engine of its size, the "Hornet" B turned in new proof of its inherent stamina. Seventy-five hours of this test were made on full throttle. The remaining 225 were run at 90% power rating—far above normal cruising speed. Immediately after the test, the engine was placed on an electric *calibrated dynamometer*, where it pulled 635 H. P. at its rated speed of 1950 R.P.M., and at 2100 R.P.M. it registered 660 H.P. Power output increased steadily throughout the test, and final teardown and inspection revealed only moderate and normal wear of moving parts.

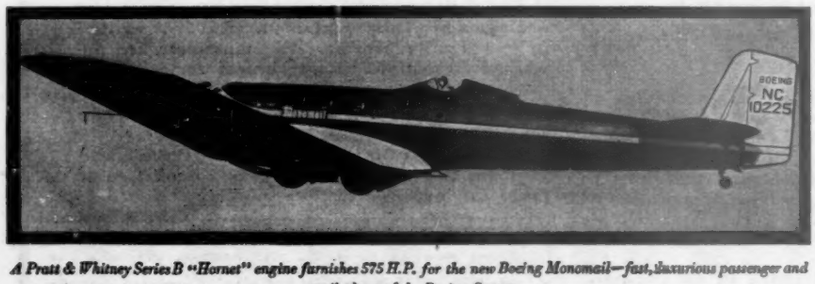


The illustration shows the new cowling developed for pusher "Hornet" B engines. It gives material improvement in speed and performance on the Fokker F-32 transport plane on which it has been installed



The Consolidated Fleetsters used by NYRBA lines, now part of Pan American Airways, are powered with Series B "Hornet" engines of 575 H.P.

No wonder Series B "Hornets" used by Western Air Express have an average of 450 hours. No wonder 36 of these engines in the service of Pan American average 424 hours per engine—and many have logged 600 hours of service under tropic weather conditions. On over 90% of the important, regularly scheduled air transport lines of this continent, engine reliability is being made a certainty by the use of "Wasp" and "Hornet" engines.



A Pratt & Whitney Series B "Hornet" engine furnishes 575 H.P. for the new Boeing Monomail—fast, luxurious passenger and mail plane of the Boeing System

Wasp* & Hornet* *Engines*

*REGISTERED TRADE-MARK

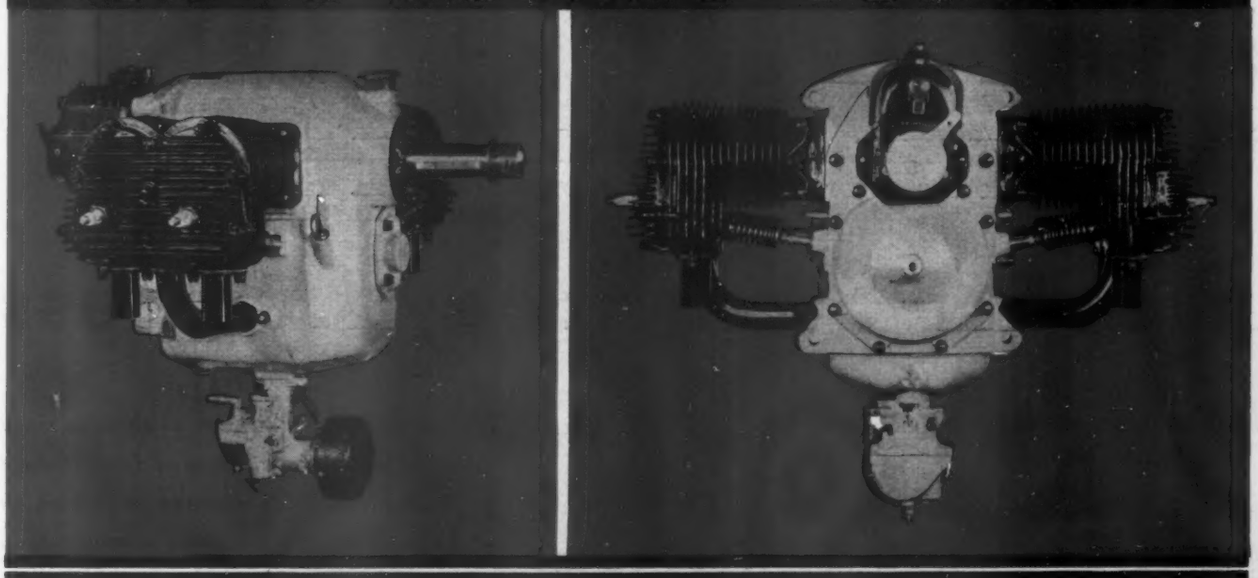
THE
PRATT & WHITNEY AIRCRAFT CO.
EAST HARTFORD . . . CONNECTICUT
Division of United Aircraft & Transport Corporation

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Quebec; in Continental Europe by Bavarian Motor Works, Munich; in Japan by Nakajima Aircraft Works, Tokyo.

Continental

OFFERS THE A-40 *for* LIGHT PLANES

FOR IMMEDIATE DELIVERY



Power—35 h. p. at 2500 r. p. m.

Weight—138 lbs. dry with magneto and carburetor.

Construction—Four cylinders, four cycle, horizontally opposed L head with direct propeller drive.

Cooling—Air cooled with fins cast on cylinders and heads.

Operation—The same smoothness characterizes the A-40 that has made the A-70 famous.

100% Visibility—Horizontally opposed cylinder construction gives absolutely unobstructed vision.

Simplicity—Extremely compact, this engine at the same time offers unusual simplicity of construction.

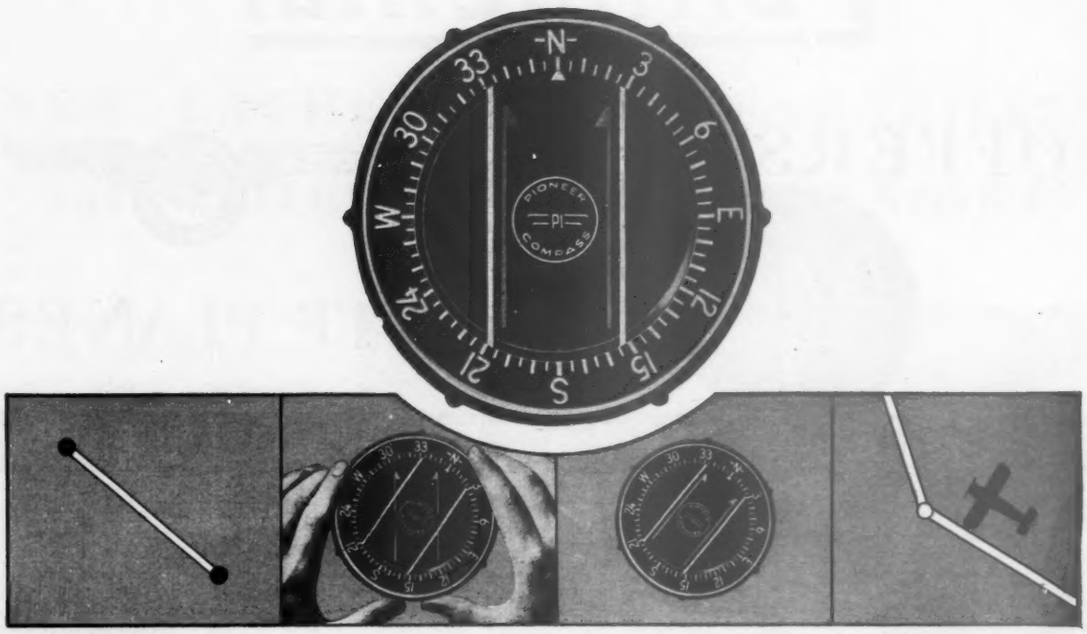
Accessibility—Supported at rear of crankcase, ready access is provided to L head valve mechanism and carburetor system. Removable heads facilitate valve grinding.

The Continental A-40, like all other Continental aircraft products, has had thorough metallurgical, dynamometer and flight tests in the most complete aircraft laboratories in the world . . . Proven by Continental—proof for the pilot.

CONTINENTAL AIRCRAFT ENGINE COMPANY
General Office and Factory, Detroit, Michigan

Continental

for the Airways of America



Pioneer Straightway Compass

The Pioneer Straightway Compass embodies three distinct advantages.

This new Pioneer compass has practically no period. After the sharpest turn it resumes the correct reading with almost no overswing or oscillation.

With the Pioneer Straightway Compass it is easy to navigate accurately. Merely set the compass circle to the desired heading. Then keep the two sets of lines parallel.

The Pioneer Straightway Compass has no parallax error. From any angle, at any time, you can check the correctness of heading at a glance.

Available with vertical or horizontal mounting bracket

The Pioneer Straightway Compass is made with the same precision as all other Pioneer instruments. It is immune to sudden or extreme changes in altitude or temperature.

The superior performance of the Pioneer Straightway Compass is obtained by reducing the weight of the magnetic element to a minimum, increasing the damping factor, yet retaining a strong magnetic control. Like all other Pioneer Compasses, it is equipped with the Titterington Micrometer Compensator and is completely radium illuminated. Write for full information.

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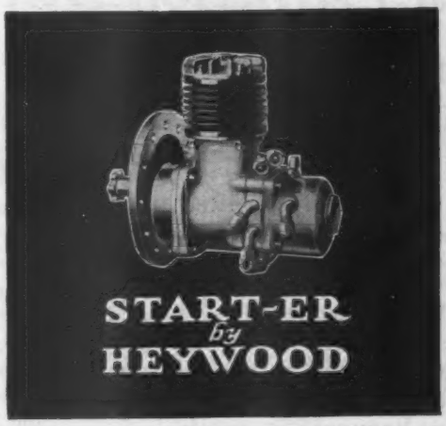
HEYWOOD STARTER

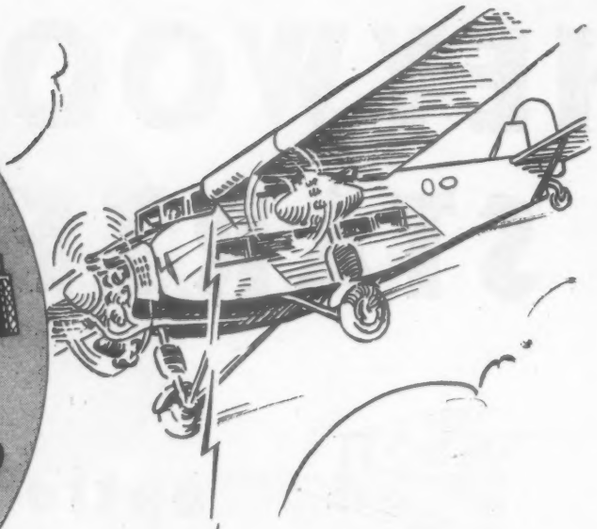
SKY SERVICE

is optional equipment with



KINNER MOTORS

SKY SPECIALTIES CORPORATION
3651 Hart Avenue **DETROIT, MICHIGAN**



Eliminates Ignition Interference

THIS new B. G. radio shielded spark plug—in conjunction with shielded magnetos and harness—eliminates all ignition interference; it keeps out dirt, water and oil, and gives positive contact.

Like other B. G. spark plugs, the new radio shielded plug is insulated with mica—the superior insulating material.

It has standard shell and core hexes, can be easily serviced with standard B. G. wrenches and tools, and assembled to harness without solder. Its terminal connections fit any make of shielded harness, and are interchangeable on all types of B. G. radio shielded spark plugs; elbow terminal prevents short-bend wear and tear on harness, is easily removed, and provides quick accessibility.

The Hornet size B. G. radio shielded spark plug has an overall length of 3" from cylinder gasket seat, and weighs only 3-1/16 ounces complete with terminal.

This new B. G. plug is made in types for super-charged and super-compressed engines, and with range of operation to meet the idling conditions of winter, as well as those of full throttle.

It is manufactured under exclusive B. G. patents granted and pending.

Write for detailed information.

NOW BEING USED BY THESE LEADING TRANSPORT COMPANIES

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Colonial Air Transport
Eastern Air Transport, Inc.
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CONTRACTORS TO THE UNITED STATES ARMY AND NAVY

Now, when production and distributing economies are most vital, here's an important fact:

You can reach 19 million people more economically from Kansas City than from any other metropolis.

If economy of distribution is of vital importance, you should learn some very interesting distribution facts by sending the coupon below.

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THE CHAMBER OF COMMERCE OF

KANSAS CITY, MO.

THE 19-MILLION MARKET

NEW IN KANSAS CITY

Mammoth downtown construction continues into 1931 in Kansas City. Steadily moving toward completion are two of the city's tallest skyscrapers, being erected by the Kansas City Power & Light Company and the Fidelity National Bank & Trust Company. The former will be Missouri's tallest building.

INDUSTRIAL COMMITTEE, CHAMBER OF COMMERCE,
KANSAS CITY, MISSOURI

Please send me the facts about Kansas City. I am interested in the _____ industry.

Name _____

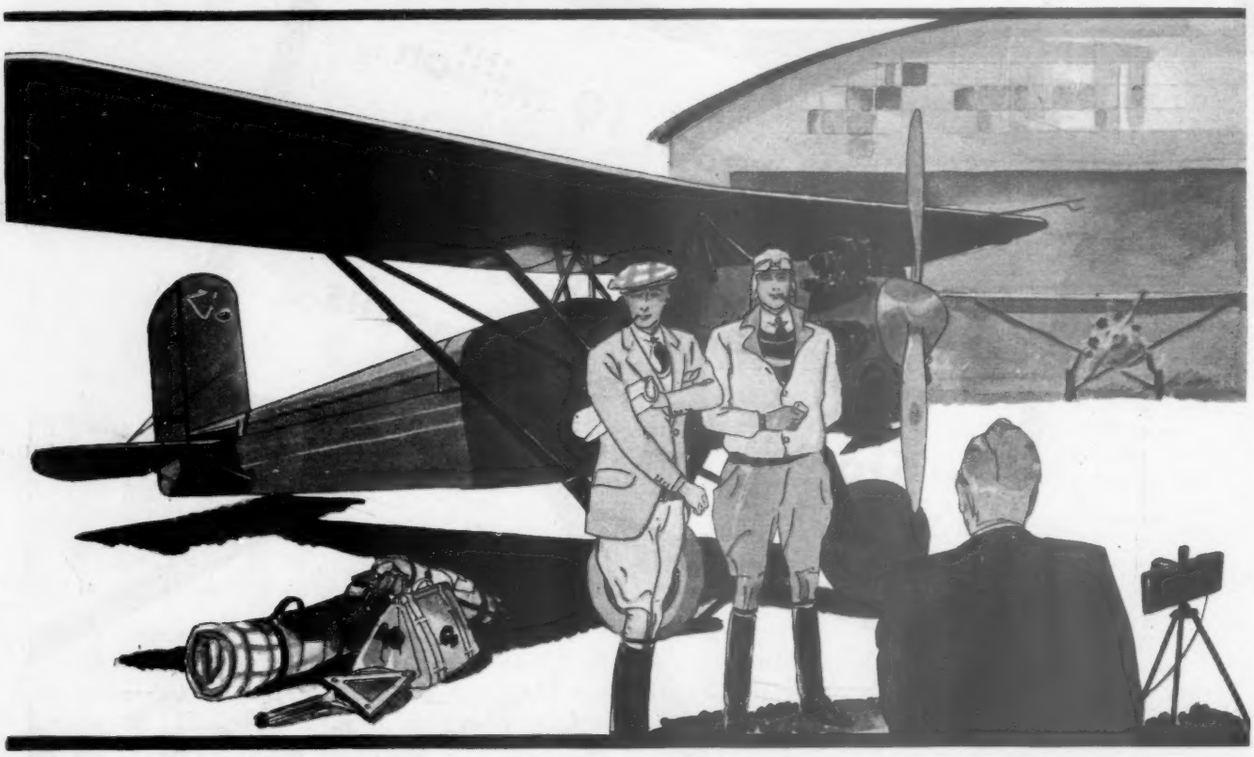
Firm _____

Address _____

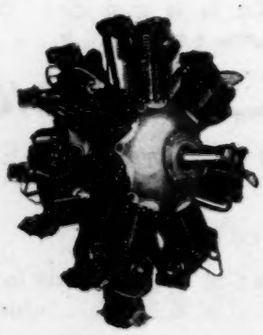
City _____ *State* _____

(I saw your advertisement in Aviation)

• mechanical excellence



The Inland Sport Monoplane has time and again proven its practicability for the man who is interested in speedy air transportation, not alone from the viewpoint of the professional pilot, but from that of the modern business man to whom aviation offers diversion and a saving of valuable time. In the Sportsman Pilots' race at the National Air Races, Inland Sports Warner-powered won first, second and third places against a distinguished field of planes driven by private pilots of national prominence.

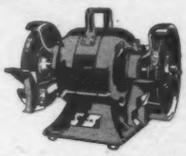


The record of Warner Scarab engines at the National Air Races, where they scored so sensationally, proves beyond all question of doubt their mechanical excellence and the advanced features of their design. For they have set a mark far beyond that ever before achieved in the annals of aviation—the winning for the third successive year of every cross country derby and closed course event in their power class, both for Cabin and Open Ships. There are engineering reasons—and a multiplicity of them—for this phenomenal performance. Pamphlets are available giving details of construction, both of the 7 Cylinder Warner Scarab 110 H.P. and of the 5 Cylinder Warner Scarab Junior 90 H.P. Write for them and find why Warners always come through—why their operating and maintenance costs are almost unbelievably low.

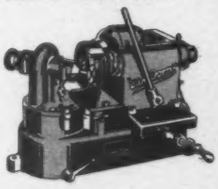
WARNER AIRCRAFT CORPORATION
DETROIT, MICHIGAN

WARNER "Scarab" ENGINES

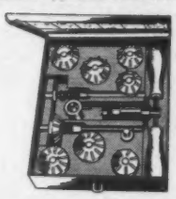
Save Time With VAN DORN ELECTRIC TOOLS



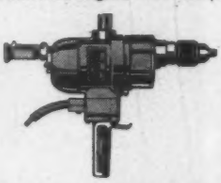
Electric Bench Grinders: Available in 6", 7" and 10" wheel sizes, complete with coarse and fine grinding wheel. 6" size shown.



Electric Valve Refacers: Reface all types of aircraft engine valves. Highly accurate and five times as fast as hand method. ⅛" size shown.

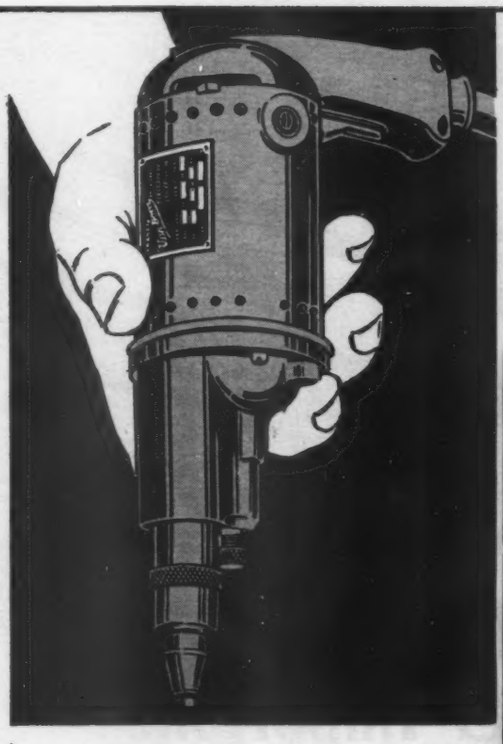


Aircraft Valve Reseating Tools: Sets containing convenient assortments of cutters, expanding pilots, etc. for reconditioning all types of aircraft engine valve seats.

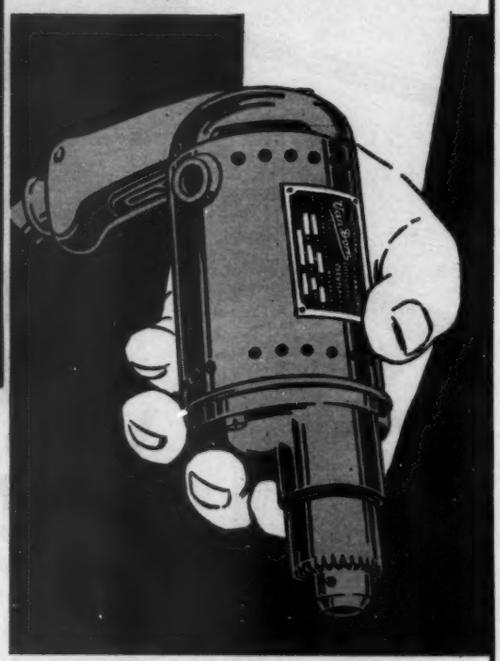


Portable Electric Drills: A size for every drilling operation, including small sizes for driving carbon cleaning and valve reseating tools. Universal motors.

Drill Stands: Bench and Post models. Quickly convert portable electric drills into powerful drill presses. A size for every Van Dorn drill.



Two NEW TOOLS *for* AIRCRAFT ASSEMBLY



Smaller, Lighter Electric Drills and Screwdrivers for Fast Work in Close Quarters.

DESIGNED for drilling small holes and driving small screws, the new Van Dorn Universal Twins make short work of many tedious jobs met in airplane manufacture.

Each is designed for rapid operation—ruggedly constructed, light in weight, powerful, easily handled, efficient in close quarters. Body diameters are small and external surfaces rounded to afford the operator easy grasp at any part.

The screwdriver is equipped with an adjustable friction clutch which drives the screw flush and releases at once—no danger of marring the screw head or surrounding surface. Clutch can be set at any desired tension for driving various types and sizes of small screws into wood or metal.

The drill is fitted with a three-jaw geared chuck of 3/16" capacity. Each tool has a Universal Motor with ball bearings on the armature shaft and spindle. Equipped with a 3-conductor cable and attachment plug. Furnished for 110, 220 or 250 volts. See these tools at your distributors. Or mail the coupon for further information about the Van Dorn Universal Twins and for the complete catalog of Van Dorn Portable Electric Tools.

Mail Coupon for Catalog!

FOR POWER SPECIFY

"Van Dorn"

The VAN DORN ELECTRIC TOOL CO.
TOWSON, MARYLAND

THE VAN DORN ELECTRIC TOOL CO.
TOWSON, MARYLAND

Gentlemen:
Please send me your catalog describing the complete Van Dorn line of portable electric tools. I am especially interested in:

☐ Universal Twins ☐ Valve Tools
☐ Bench Grinders ☐ Electric Drills
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60 Important Victories & Records
IN THE AIR

SPEED records . . . altitude records . . . endurance records! Sensational victories in closed course events and distance flights over land and water! Triumphs under every flying condition . . . in competition with every leading brand of gasoline!!

That is Richfield's record in aviation for 1930 . . . a record that eclipses all its great performances of the past. Remember, too . . . that in *commercial* aviation Richfield flies *more air transport miles daily than any other gasoline!*

Certainly any gasoline that can perform so consistently . . . that can win so decisively must have definitely superior qualities. And Richfield has . . . power, speed and perfect carburetion . . . insuring fast, sustained, trouble-free flight at all times.

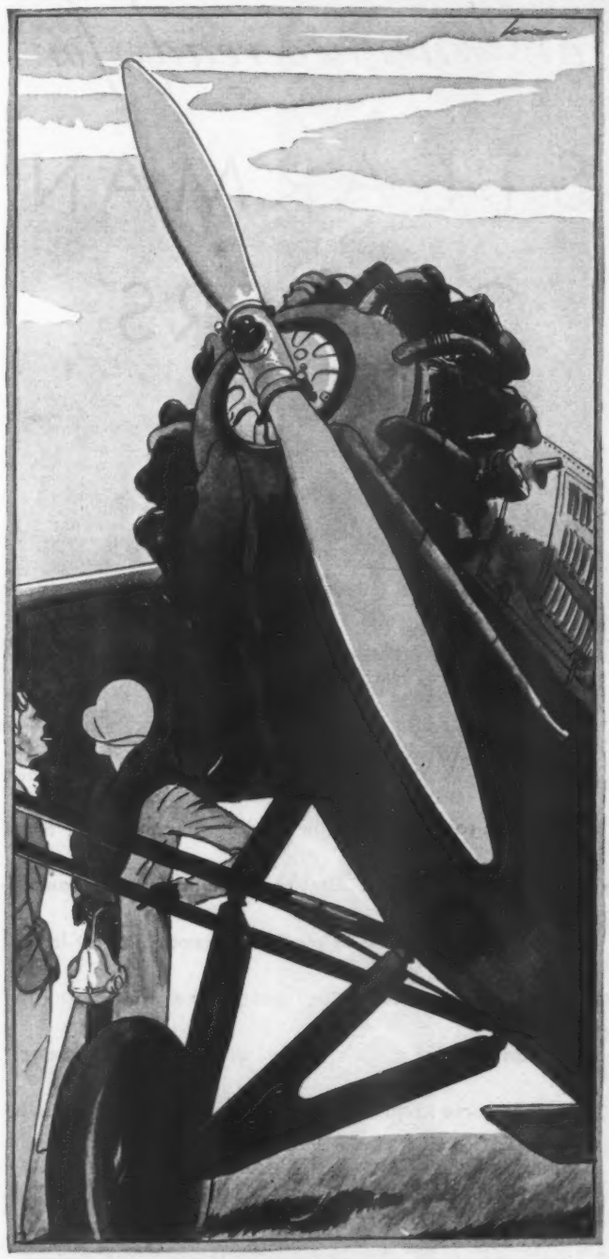
Get this great gasoline for your own plane . . . at important airports both east and west of the Mississippi.

RICHFIELD OIL COMPANY . . Los Angeles . . New York City

RICHFIELD
AVIATION GASOLINE

RICHFIELD

WRIGHT ENGINES BRING MORE POWER TO 1931 PLANES!



IN rigorous service flights during the past two years, Wright has operated "Whirlwind 300's" under conditions that require from thirty to fifty per cent overload!

The "Whirlwind 300" in the Travel Air "Mystery" ship which swept the races at Cleveland and won the world's record for commercial planes, has given continuous and efficient service while delivering over 400 horsepower!

The "Whirlwind" that hurled Frank Hawks' "Texaco 13" across America at 215 m.p.h. and repeatedly at over 250 m.p.h. has performed most satisfactorily while turning out 400 horsepower and more!

That's the kind of performance you get when you fly behind an engine by Wright. Pilots know it by experience. Owners and operators know it by service checks. Passengers know it by smooth, dependable travel.

For the striking improvements that made these flights possible, as well as those in the new "Cyclone 575," choice of Colonel Lindbergh and Lieutenant Al Williams, are constantly being incorporated into regular production Wright engines!

To build one engine that leads one class is one thing. To build engines that fit every flying need, and to keep each engine far in front is another thing. Yet that's what Wright has done for years, and what these constant developments do again for Wright owners of 1931!

WRIGHT
AERONAUTICAL CORPORATION
PATERSON, NEW JERSEY
A DIVISION OF CURTISS-WRIGHT CORPORATION

The air-lanes are ready for

STEARMAN OWNERS

WATCH the Stearmans down there on the runway .... soon to leave the new Stearman factory. Fine ships, those Stearmans. They're warming up — distances beckon. What a wealth of pleasure ahead. The air-lanes are ready .... reaching out across the continent are Stearman facilities .... It's "home" wherever Stearmans go. Flying will come to this .... Stearman, backed by United, is pointing the way. STEARMAN AIRCRAFT COMPANY, WICHITA, KANSAS. Division of United Aircraft and Transport Corp.

Junior Speedmail 300 and 400 H. P. .... Business Speedster 240 H. P.

for every flying reason

STEARMAN

A SENSE OF SECURITY
is an added comfort

The luxurious interiors of planes, their Pullman-like appointments and the application of every known safety device have all contributed their share to the ever-increasing popularity of air travel in this country.

But crowd-control at landing fields is just as important as a safety factor. If crack pilots are unnerved by a crowded field, what feelings must the unexperienced air-traveler suffer.

Many transport operators have solved this problem by enclosing the promenades and parking areas with Anchor Fences, thereby insuring a clear field for landing planes. An Anchor Fenced field sighted by a passenger gives him a sense of security, which is truly a real added comfort.

AN ANCHOR FENCE doing crowd-control duty during the landing of Coste's plane.

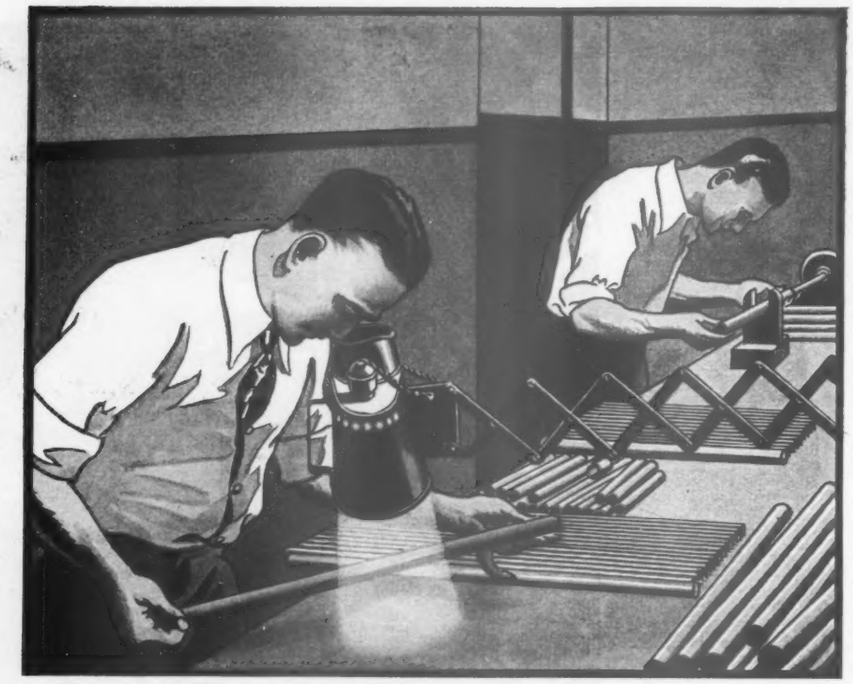
ANCHOR POST FENCE COMPANY
Eastern Avenue and Kane Street, Baltimore, Maryland

Albany Boston Buffalo Charlotte Chicago Cleveland
Detroit Hartford Houston Los Angeles Mineola, L.I. New York
Philadelphia Pittsburgh St. Louis San Francisco Shreveport

Representatives in all principal cities. Consult your local classified directory.

ANCHOR FENCES

MADE BY THE MAKERS OF AMERICA'S FIRST CHAIN LINK FENCE



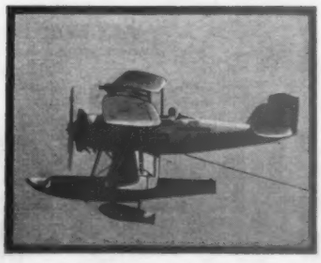
BUILDING STAMINA INTO CHANCE VOUGHT AIRPLANES

To this inspection table comes every tubular part—and only perfect units ever pass it.

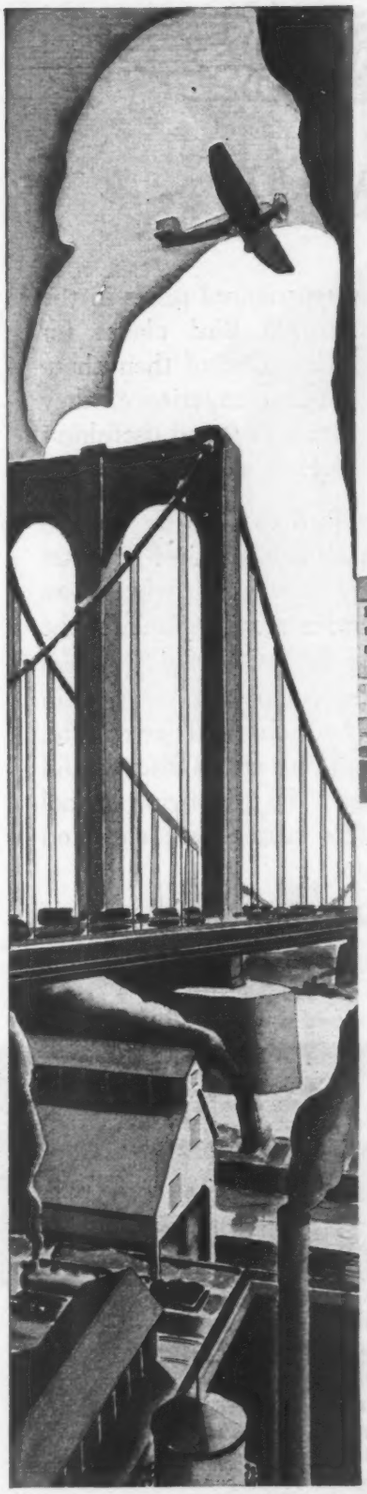
Welded into the engine mount and fuselage of every Chance Vought airplane are dozens of pieces of tubular steel. Rigid specifications fix the formula for the material. Careful inspection and tests of stock as it is received make certain that it meets requirements in strength, hardness, ductility and elasticity.

Then, when frame members are cut for assembling, after sand blasting to remove all dirt and grease, they pass to the inspection table shown above. Electric spinning and a high intensity inspection lamp equipped with magnifying lenses help skilled inspectors to spot the smallest flaw. And only perfect parts pass on.

There you have one of the basic reasons why Vought planes stand up in the rigorous service of the Navy and the Marine Corps. Launched from catapults . . . landed on surging steel decks . . . halted by relentless arresting gear . . . these airplanes, built in the modern Vought plant at East Hartford, thrive on hard service. Chance Vought Corporation, East Hartford, Connecticut. Division of United Aircraft & Transport Corporation.



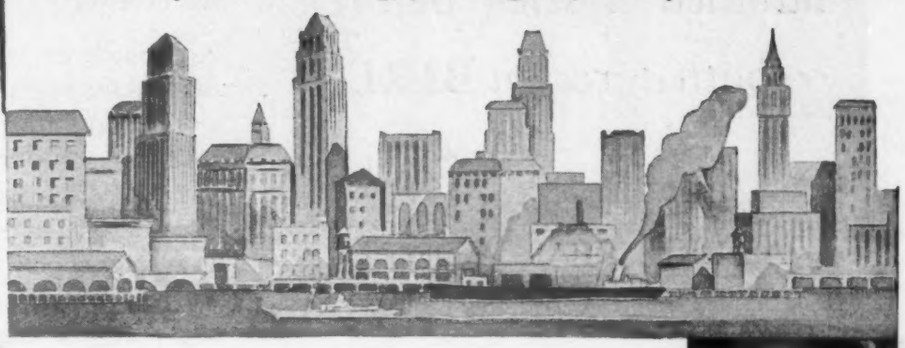
CHANCE VOUGHT CORPORATION



AMERICAN STEEL SHEETS

QUALITY— AMERICAN SHEET AND TIN PLATE COMPANY PITTSBURGH —SERVICE

For Airport Buildings, Hangars, Shops and Sheds



Unexcelled for All Construction Uses—Above or Below Ground

STEEL SHEETS are serving an important and ever growing list of uses. For roofing and siding in industrial construction; for gutters, spouting, flashings, metal lath, and similar uses in well-built structures; for ventilating and air-conditioning systems in great skyscrapers; for molding, sash, trim and doors in fireproof buildings; and for metal furniture, cabinets, and equipment for both office and home. Also in growing demand for airfield work, culverts, and underground uses.

Be sure the sheet metal you use has a reputation for quality and endurance. Specify AMERICAN Black and Galvanized Sheets, Tin and Terne Plates for all purposes. KEYSTONE quality (steel alloyed with copper) gives maximum rust-resistance. Sold by leading metal merchants.

US STEEL

American Sheet and Tin Plate Company

GENERAL OFFICES: Frick Building, PITTSBURGH, PA.

SUBSIDIARY OF UNITED STATES STEEL CORPORATION

KEYSTONE AMERICAN

PRINCIPAL SUBSIDIARY MANUFACTURING COMPANIES:

AMERICAN BRIDGE COMPANY
AMERICAN SHEET AND TIN PLATE COMPANY
AMERICAN STEEL AND WIRE COMPANY
CARNEGIE STEEL COMPANY
COLUMBIA STEEL COMPANY
CYCLONE FENCE COMPANY
FEDERAL SHIPB'LDG. & DRY DOCK CO.
ILLINOIS STEEL COMPANY
NATIONAL TUBE COMPANY
THE LORAIN STEEL COMPANY
TENNESSEE COAL, IRON & RAILROAD CO.
UNIVERSAL ATLAS CEMENT COMPANY

Pacific Coast Distributors—Columbia Steel Company, San Francisco, Calif.
Export Distributors—United States Steel Products Company, New York, N.Y.

BIRD

THE SAFE AIRPLANE - - -

- - Experienced pilots, and students who never handled a stick before ---both agree on **BIRD**!

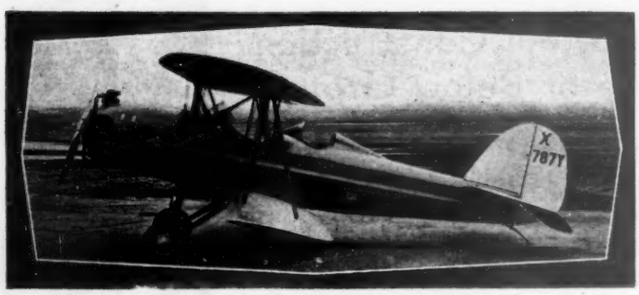
* * * *

BIRD'S NEW FRANCHISE ASSURES REAL PROFITS FOR DEALERS.

Scores of the most experienced pilots in the country have purchased Bird planes for their own private use. Out of their thousands of hours of flying experience, they quickly recognize Bird's all-round usefulness and noteworthy value.

But confidence in Bird extends far beyond the ranks of experts - it is matched by other scores who scarcely know an air-wheel from an aileron. For Bird is the *safe* plane for the average person to fly. One flying school soloed 53 students, four of them women, in an average of only five hours and one minute. To the private pilot, Bird means Safety - and safety at low cost. To the flying school operator, Eird offers satisfied students and profitable operation.

Write - today - for new catalog, more details, or demonstration.



The 125 H. P. 4-Place Kinner-BIRD

● *This newest addition to the* BIRD *line retains the identical design of the famous* BIRD *90 H. P. Kinner . . . the ship that received the highest rating of any plane, not equipped with special appliances, in the Guggenheim Safety contest. The only change is that it has been strengthened to accommodate the increased power and the extra passenger. It carries four people in comfort, cruises easily at 100 m.p.h., and may be fitted for dual instruction in 10 seconds. ¶Price, F.O.B. factory, $4,395, completely equipped.*

The 110 H. P. Warner-BIRD

● *This 3-place ship completes the* BIRD *line to meet individual power-plant preferences. ¶Price, F.O.B. factory, $4,250, completely equipped.*

The 100 H. P. Kinner-BIRD

● *For all-round use, including passenger carrying and student instruction, this 3-place* BIRD *has already established itself as the experienced pilot's favorite ship - - - Nowhere else can you find so much airplane for $3,895, F.O.B. factory, completely equipped.*

● ***A limited number of Three-place, open cockpit OX-5 BIRDS, with New Engines, are available at $2195*** ●

BIRD AIRCRAFT CORP.

GLENDALE, L. I. - - NEW YORK, N. Y.

MADE ENTIRELY OF STEEL

BUTLER

READY-MADE

STEEL HANGARS

THIS ONE HAS BEEN ERECTED—TAKEN DOWN AND RE-ERECTED

It appears "spanking" new, but before erecting it at the Union Airport, Lincoln, Nebraska, the Woods Brothers Corporation used this hangar on a temporary location for several months. It was erected, taken down and re-erected with full salvage.

Completeness, economy in acquiring, economy in maintenance, fire safeness, speed in erection, trim appearance and structural qualities which make for permanence, yet which permit enlarging, taking down and re-erecting—these are characteristics of Butler Ready-made Steel Hangars. Their sum total is the common sense solution of the airplane sheltering problem.

Butler Ready-made Steel Hangars range from the individual T-shape type shown here to the immense, round roof, airport type with clear spans up to 100 feet. They serve many air industry purposes such as transport line stations, flying school hangars, and training quarters, aircraft factory buildings, repair shops, material warehouses, lunch rooms, refueling stations, shelter for ground equipment, et cetera. Butler designs also include combinations of steel and stucco, and steel with brick veneer. Butler Ready-made Buildings have set the standard for economical airport structures.

A new booklet pictures installation of Butler Individual and Commercial Airport Hangars. Butler engineering service will supply full information and prices if you will mention the size building in mind.

Butler Manufacturing Company

1245 Eastern Ave., Kansas City, Mo.
945 Sixth Ave., S. E. Minneapolis, Minn.

Please send new booklet and information on Individual Hangar for sheltering..... airplane; commercial hangar.....ft. x.....ft. in size; .....ft. x.....ft. Ready-made Steel Building for.....

Firm Name .....

By .....

Address:.....

City..... *State*.....

Do you know that . . .

each month our subscription department receives more than 150 requests for "Back" issues of AVIATION?

◆ ◆ ◆

If we printed extra copies of our monthly issues, we would be glad to comply with these requests, but unfortunately we have no way of knowing in advance just how many of our newsstand readers will "miss" an issue.

◆ ◆ ◆

But We Do Know **— that each of these requests indicates a reader has "missed" just the issue he could make valued use of.**

Insure your receiving AVIATION *regularly by filling in the coupon below, today . . .*

AVIATION
10th Avenue at 36th Street
New York City

◆

Subscription Rates:
U. S., Canada and Mexico, $3;
Central and South America, $6;
all others, $8.

Here is my check for $3.00. Send me Aviation for one full year.

Name .....

Address .....

City and State .....

Nature of Activity .....

For complete mastery in ground maneuvers

BENDIX

WHEELS AND BRAKES

A new and generous factor of safety, due to greatly increased efficiency in all ground operations—these have established Bendix Wheels and Brakes firmly among the preferences of leading aeronautical engineers.

Alexander Industries, Inc.
Bellanca Aircraft Corporation
Boeing Aircraft Company
Buhl Aircraft Company
Cessna Aircraft Company
Consolidated Aircraft Corp.
Curtiss Aeroplane & Motor Company
Curtiss-Robertson Airplane Manufacturing Company
Curtiss-Wright Airplane Company
Douglas Aircraft Company, Incorporated
Fairchild Airplane Mfg. Co.
Fokker Aircraft Company
Keystone Aircraft Corporation
E. M. Laird Airplane Company
Lockheed Aircraft Company
Ryan Aircraft Corporation
The Glenn L. Martin Company
Northrup Aircraft Company
Pitcairn Aircraft, Incorporated
Spartan Aircraft Corporation
Stearman Aircraft Corp.
Verville Aircraft Company
Chance Vought Corporation
U. S. Air Corps (for all ships)
U. S. Navy (Bureau of Aeronautics) etc.

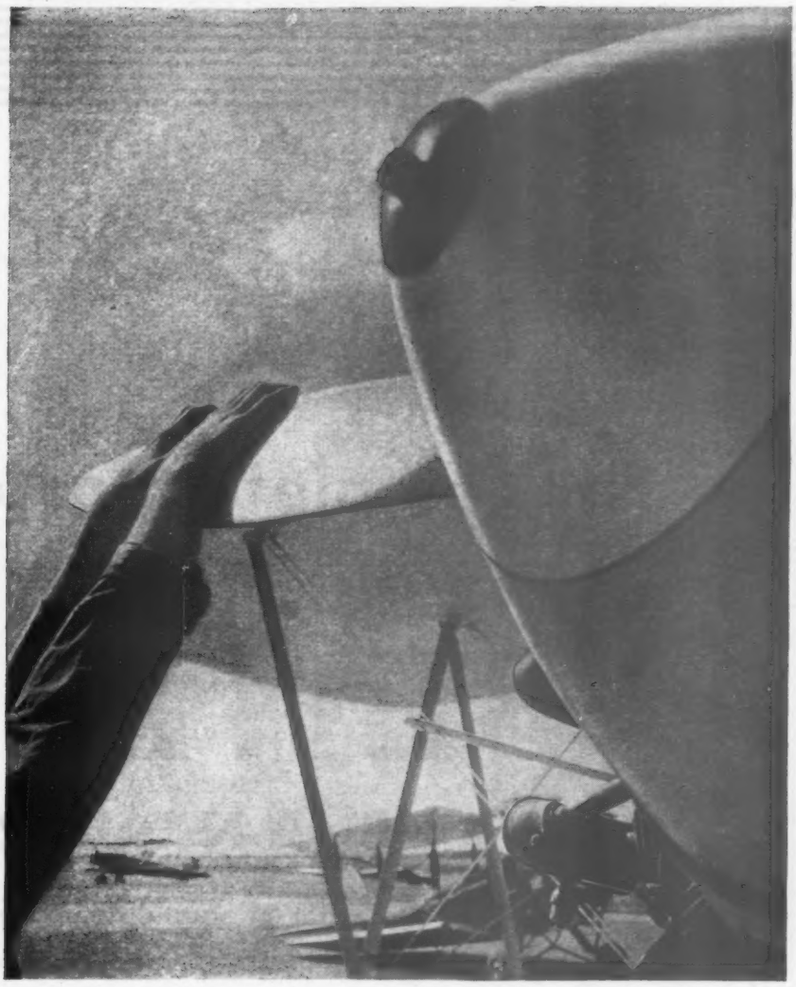
BENDIX BRAKE COMPANY
SOUTH BEND, INDIANA
(Division of Bendix Aviation Corporation)

BENDIX 4 BRAKES

FOR SAFETY

FULLY PROTECTED BY PATENTS AND APPLICATIONS IN U. S. AND ABROAD

Air Mail Saves Time



CONTACT!

CONTACT! Spin the prop. . . Fueled with Socony Aviation Gasoline, she starts quickly. No "loading up" or flooding at the carburetor. A few minutes to warm her, and you're ready to take off.

You'll get as many r.p.m.'s as your motor was built to deliver, when you use Socony Aviation Gasolinc and the New Socony Motor Oil. These Socony products are on sale at nearly every large airport in New York and New England.

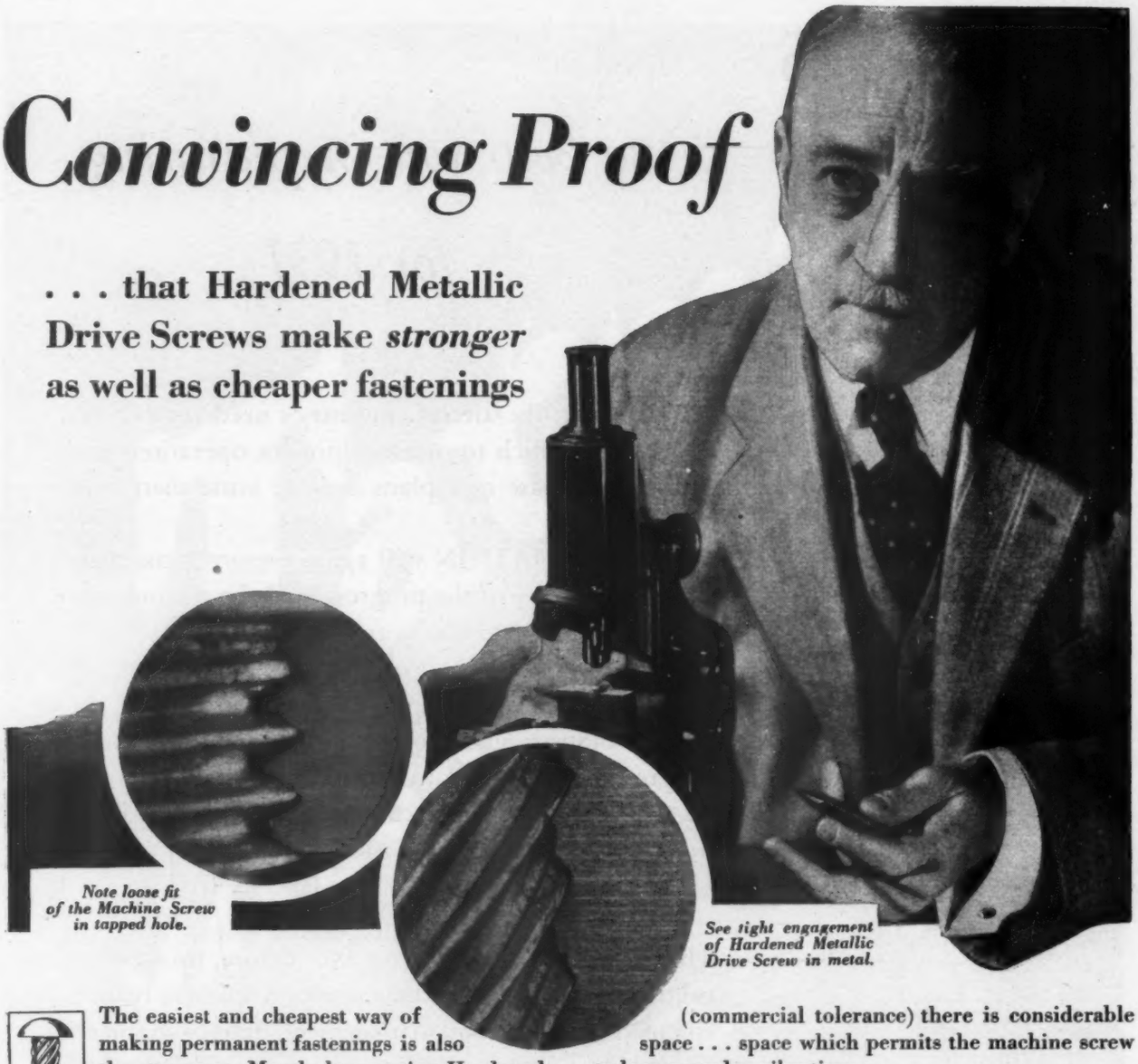
SOCONY

AVIATION GASOLINE NEW SOCONY MOTOR OIL

STANDARD OIL COMPANY OF NEW YORK

Convincing Proof

. . . that Hardened Metallic Drive Screws make *stronger* as well as cheaper fastenings



The easiest and cheapest way of making permanent fastenings is also the strongest. Merely hammering Hardened Metallic Drive Screws into holes, drilled or formed in iron, brass and aluminum castings, steel or Bakelite, makes better fastenings than those made with machine screws or bolts and nuts. This is proven by comparative laboratory tests conducted by unbiased authorities.

A convincing explanation of the greater holding power of a Hardened Metallic Drive Screw under vibration, the chief cause of fastening failure, is offered by the microscope. Remembering that the security of a fastening under vibration depends upon how tightly the Screw threads are engaged in the metal, look at the unretouched microphotographs here. It is easy to see why the Hardened Metallic Drive Screw holds better.

Note how this unique Screw forms a thread in the metal as it is driven . . . how that action embeds the screw threads so firmly in the metal that screw and metal are practically one. Then observe that between the machine screw threads and the tapped threads (commercial tolerance) there is considerable space . . . space which permits the machine screw to loosen under vibration.

Under stresses of tension and shear, a stronger fastening is obtained with a Hardened Metallic Drive Screw because it possesses greater tensile strength than an ordinary screw, being made of a special steel, scientifically treated.

The booklet offered here shows how users of these Screws effect substantial savings through elimination of slow and costly tapping, fumbling with bolts and nuts and other assembly difficulties. Use coupon to obtain it.

PARKER-KALON
HARDENED TYPE U TRADE MARK METALLIC
Drive Screws
PAT. JAN. 29, 1924-No. 1482151-OTHERS PENDING

Parker-Kalon Corp., Dept. M., 192-200 Varick St., New York.
Send free booklet on Economy and Security of Drive Screws.
(Samples for trial will be sent if you tell us what you fasten.)

Name and Co.----------

Address----------

FACTS

to help you in planning for 1931

THIS year, the aircraft industry's need for reliable data by which to measure present operations and on which to base new plans is more acute than ever.

In March, AVIATION will again present a complete statistical picture of the progress made by the industry during the last calendar year.

Because of the excellence of this service in the past, the aircraft industry and those especially interested in its progress have learned to rely upon AVIATION for the most complete and accurate compilation and intelligent interpretation of basic facts that is available anywhere.

This year, more perhaps than ever before, this statistical data will be of immediate practical value to readers engaged in finance and management, design, engineering, production and sales promotion, air transport and fixed base operations, and in construction and management of airports.

Every executive in your organization should have a copy of the March Statistical Issue for reference throughout the year.

ADVERTISERS: ***Forms for the Statistical Issue will close February 13. Color will be available at $50 per page for red or blue, $60 for other commercial colors.***

THE STATISTICAL ISSUE—MARCH

AVIATION

Air travel is the most modern and most luxurious form of human transportation, and that is one of its principal claims for success. But in most cases today, it begins and ends in the most primitive fashion... in mud.

This is no longer necessary. Great progress has been made recently in airport-surfacing with limited funds. The experience of the highway industry in the construction, with Tarmac, of vast areas of secondary roads under small budgets has been applied to airport paving.

Let us tell you how this can be done on your runways with Tarmac* at small cost.

*Serving the States East of the Rockies.

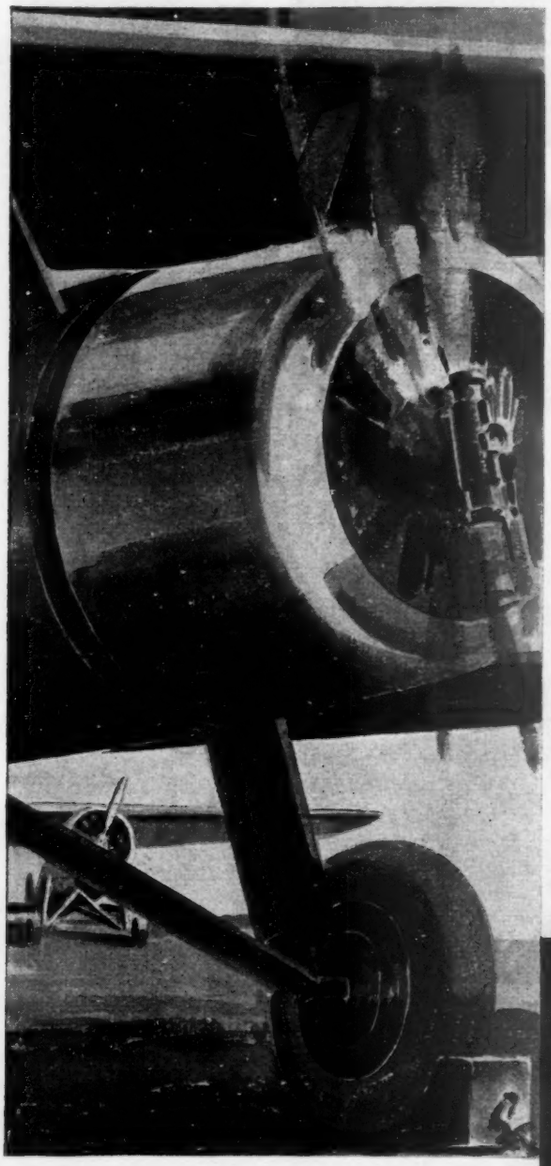
AMERICAN TAR PRODUCTS COMPANY
Division of The Koppers Company
General Offices: PITTSBURGH, PA.

Surface with **Tarmac**

RUNWAYS ... PARKING AREAS..HANGAR APRONS CONNECTING ROADS TAXI STRIPS.....AT MODERATE COST...

Copyright 1931 American Tar Products Co.

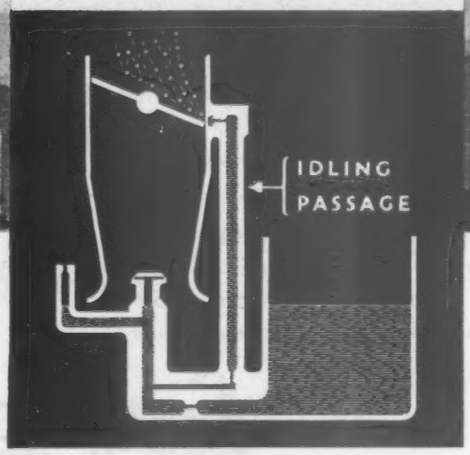
Smooth IDLING»



SMOOTH low speed operation is now possible in air-craft engines. One reason is that Stromberg Carburetors fuel the engines uniformly at low speed, keep them running smoothly, evenly, yet able to pick up at the slightest touch of the throttle.

To assure low speed fuel delivery, Stromberg Carburetors have a thin tube, or idling passage, from the fuel chamber to the top of the carburetor just above the throttle. With throttle completely closed, and the engine turning over slowly, there is sufficient suction to raise the fuel through the idling tube into the engine. At low speeds, the idling system operates entirely independent of the main fuel metering passages of the carburetor. As the throttle is opened, and the suction in the carburetor increases, fuel begins to flow through the main system, and delivery from the idling system decreases.

Stromberg engineers, with 22 years of carburetion experience, will gladly cooperate in working out any carburetion problem.



«Over 95% of the aircraft engines being built in the United States today are Stromberg equipped»

STROMBERG CARBURETORS

BENDIX STROMBERG CARBURETOR COMPANY

«DIVISION OF BENDIX AVIATION CORPORATION»

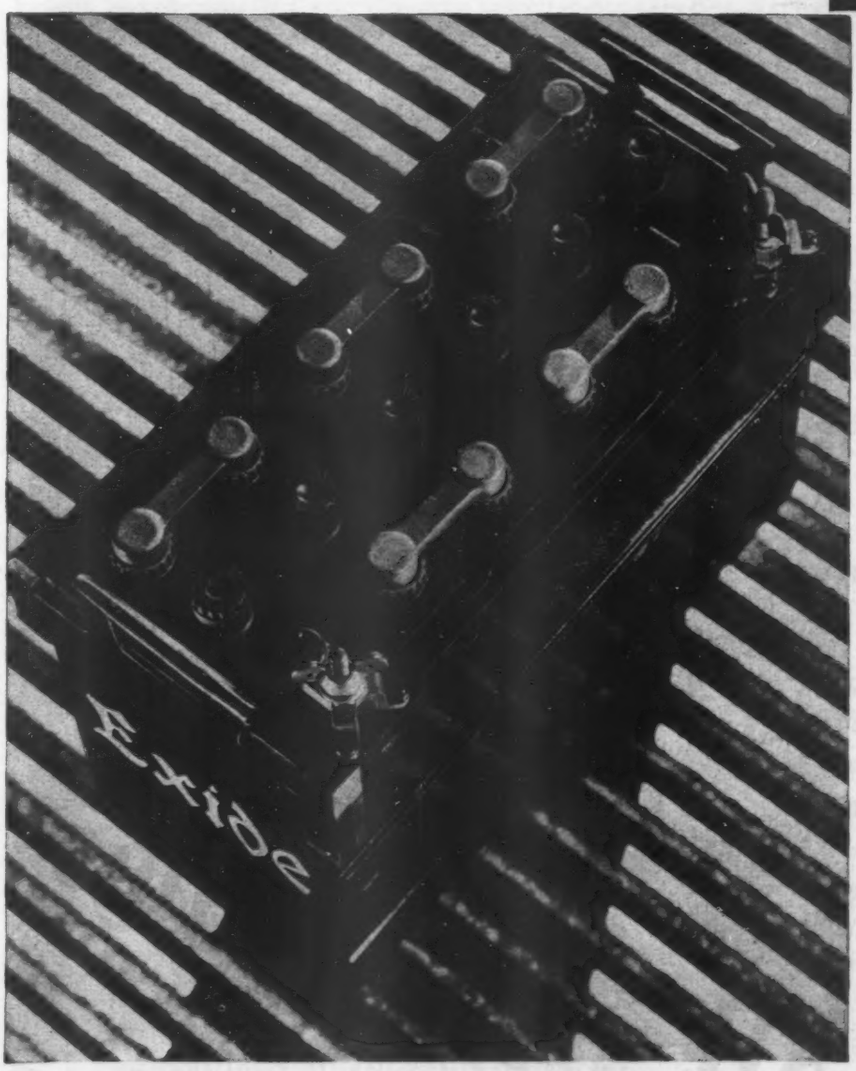
701 BENDIX DRIVE • SOUTH BEND, INDIANA

a Battery *made* to fly

. . . light-weight . . . compact . . . safe

Exide Aircraft Batteries are especially built to meet rigid air requirements

Out of the black of night onto the field in safety. Landing lights can be depended on with Exides on the job.



The Exide Aircraft Battery is especially designed for hard flying service

THE most vital parts of a "ship" are dependent on the battery carried. Starting, ignition, cabin lights, avigation and landing lights, instrument board and radio must be certain of electric power. You *can* be sure with Exide Aircraft Batteries in your fuselage.

Exides are so designed that the electrolyte will not spill. They have proved their worth over millions of miles of sky lanes . . . in all kinds of weather.

Ask your flying friends about Exides . . . about their reliability. Or write today for further information on the many types of Exide Aircraft Batteries and their varied applications.

Exide
AIRCRAFT
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Exide Batteries of Canada, Limited, Toronto

Four Place Stinson Junior, Powered with 210 H. P. Lycoming Engine.

SRB Ball Bearings are used at all Important Points in Lycoming Aircraft Engines

FOR the radial loads on the crankshaft, to sustain the propeller thrust and support the rocker arms, Lycoming have chosen SRB —because SRB with its maximum number of large balls, hot forged from molybdenum steel, gives the utmost in load carrying capacity and that dependability so necessary in aeronautical power plants.

That is why SRB Ball Bearings predominate in the aircraft engine field and are found in Wright, Curtiss, Pratt and Whitney, Warner, LeBlond, Velie and other well known engines.

Specify SRB, the aeronautical ball bearing for absolute dependability in your own equipment. Make sure that the ball bearing specification is worthy of the equipment you build. SRB engineers will be glad to cooperate with your engineering department.

Ball SRB Bearings

STANDARD STEEL AND BEARINGS INCORPORATED
Plainville *Connecticut*
DIVISION OF MARLIN-ROCKWELL CORPORATION

PACIFIC COAST DISTRIBUTORS
F. M. Cobbledick Co., San Francisco, Cal. E. D. Maltby Co., Los Angeles, Cal.
Northwest Bearings Co., Seattle, Wash.

Lower Motor Maintenance Costs

The length of time between necessary service overhauls and the cost of these overhauls is a principal factor in figuring operating efficiency. When motor maintenance runs abnormally high—profits disappear. Quality lubricants will lower maintenance costs and increase the operating time between overhauls.

Gulfpride Oils

Are America's Highest Quality Aircraft Oils

Extensive research by the Gulf Refining Company is responsible for GULFPRIDE—refined specially for Aircraft use. GULFPRIDE OILS are available at principal airports.

Take a tip from the headline flyers. Use GULFPRIDE regularly and note the difference.

GULF REFINING COMPANY

RALPH STARR BUTLER

Vice President in charge of Advertising

General Foods Corporation

"I cannot believe that the present enormous budgets would have been voted by responsible business men without such a measuring stick as the A. B. C. provides. Its foundation marks the turning point in advertising."

Advertisers, men who direct the budgets of great companies . . .

Men who spend money for space in order to promote more profitable business . . .

Looking back over the active decades, they search out the turning point in American Advertising, the period when the confidence of business was won.

Independently, they agree on time and place.

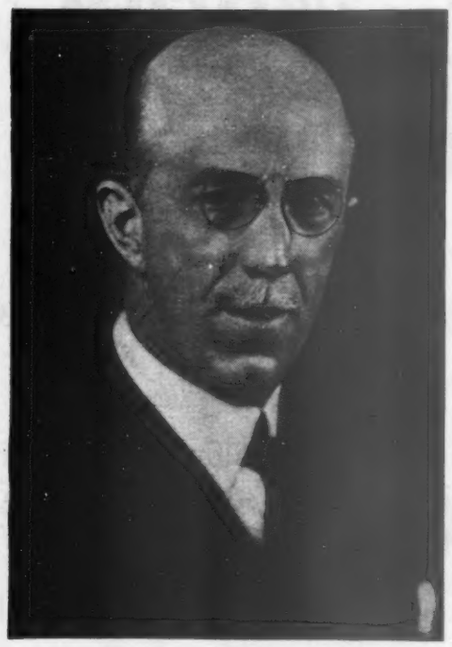
It was the discovery of the Yardstick . . . The finding of a unit of measure for the value of advertising space. A unit as positive, as reliable, as the measure for coal or wheat.

PHIL L. THOMSON

Director of Public Relations

Western Electric Company

"Business would never have spent millions to buy circulation by the pile. Accustomed to purchase copper, lumber or lead by an accepted unit of measure, we asked the same type of yardstick for space. The A. B. C. gave it to us."



Sixteen years ago a group of advertisers met with publishers and agencies in Chicago. To bring order out of chaos in circulation claims, they founded, on May 20, 1914, the Audit Bureau of Circulations.

In 1914, publication advertising totalled about $250,000,000. In 1927, year of the latest government report, it had reached over a billion dollars.

That this growth could not have come without the A. B. C. is the judgment of advertisers themselves.

Founded at the instance of advertisers, having advertisers in the majority on its Board of Directors, the A. B. C. exists to safeguard the interests of advertisers.

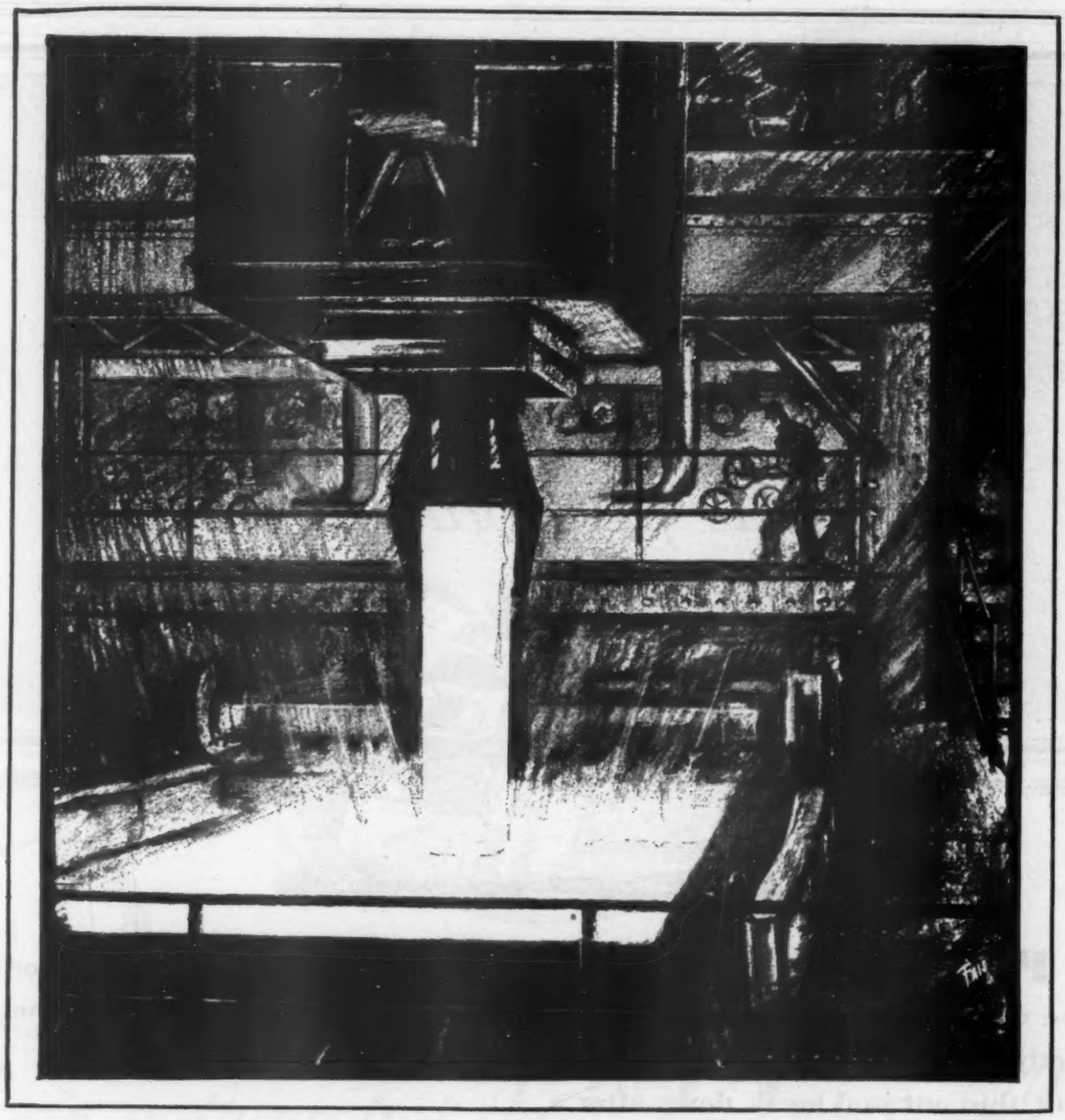
For them, it forms the bulwark against the chaos that once was advertising. It has enabled them to buy advertising with confidence.

In recognition of this service, an increasing number of leading advertisers hold membership today in the Audit Bureau of Circulations.

An Advertisement by

AUDIT BUREAU OF CIRCULATIONS

Executive Offices . . . Chicago



Down, down . . . into the Soaking Pit

A red ingot of acid steel from the open-hearth mill. Now, it is going into the soaking pit to insure thorough, uniform heating throughout. Then, sparkling white—on through to the blooming mill.

Seemingly endless are the operations in the making of Roebling Aircraft Wire, Strand and Cord. Each calls for a highly specialized skill and experience. Fine craftsmanship prevails throughout the entire range.

At Roebling the most modern of manufacturing methods and machinery are daily producing thousands of feet of Roebling Wire Aircraft Products. But tradition plays a part, too. It is old-fashioned thoroughness that guards that extra measure of service for which these products are noted.

JOHN A. ROEBLING'S SONS COMPANY
WIRE . . . WIRE ROPE . . . WELDING WIRE . . . FLAT WIRE
COPPER *and* INSULATED WIRES AND CABLES
WIRE CLOTH *and* WIRE NETTING
TRENTON, N. J. *Branches in Principal Cities*

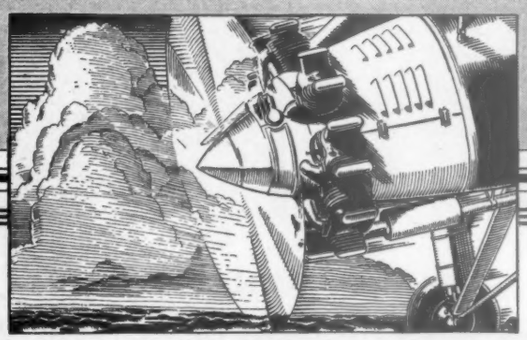
ROEBLING WIRE AIRCRAFT PRODUCTS

PENNZOIL*

FOR WINTER

an ideal lubricant
for airplane motors

Costs less per flying hour



PENNZOIL for Winter starts easily in the coldest weather and lubricates perfectly under all flying conditions. It doesn't thin out and break down after a few hours' flying like ordinary oils.

Because of its reliability and economy, it has been adopted by America's great passenger lines and is used by good operators everywhere.

It lasts twice as long as ordinary oils, giving you many extra hours of flying with every filling.

Pennzoil is made from 100% Pennsylvania crude and nothing else. It differs from all other Pennsylvania oils because of the famous Pennzoil process which uses only the heart of the crude—the fraction richest in lubricating efficiency. Sold by good dealers from Maine to California.

THE PENNZOIL COMPANY. Executive Offices and Refinery: Oil City.
Division Offices: New York, Chicago, Los Angeles

***It isn't enough to ask for "Pennsylvania oil"
—to be sure of lowest cost per mile, say "PENNZOIL"***

35¢ a quart

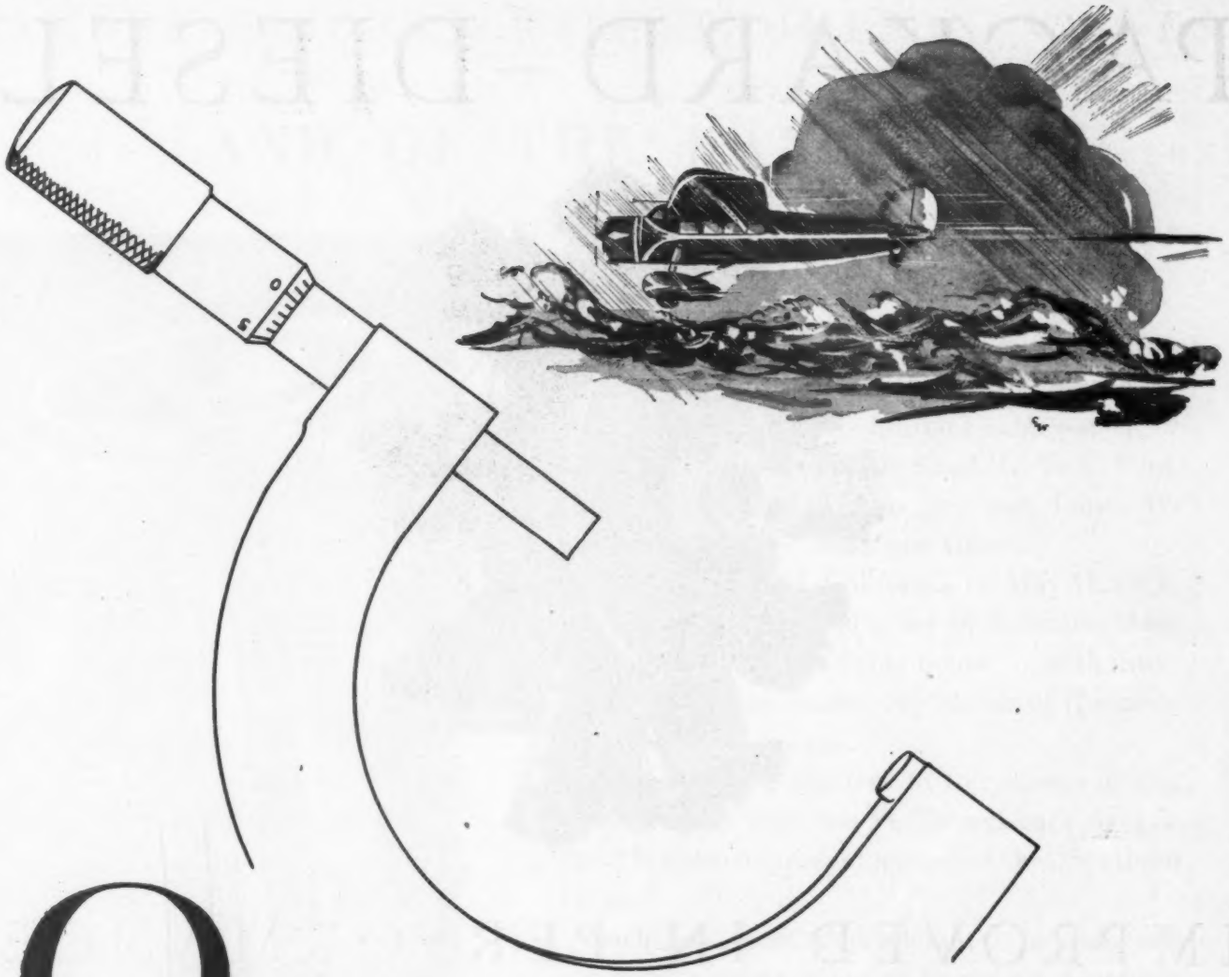
Slightly higher in Canada

100% PURE PENNSYLVANIA
PENNZOIL
SAFE LUBRICATION

Hear Pennzoil Pete and Andy Sannella's All Star Orchestra over WJZ and other N. B. C. stations Sunday evenings 10:15 Eastern Standard Time.

PERMIT NO. 2—PENNSYLVANIA GRADE CRUDE OIL ASS'N

This seal is more than a pledge of 100% Pure Pennsylvania. It is our guarantee to you of highest quality finished Motor Oil.



ONE PLACE
where nothing but the BEST *will do*

IT IS written indelibly into Aviation precepts that only the best of engineering talent may design engines and engine parts, and likewise, that only those shops whose experience, equipment and code have given them a standard of exacting accuracy to produce these parts.

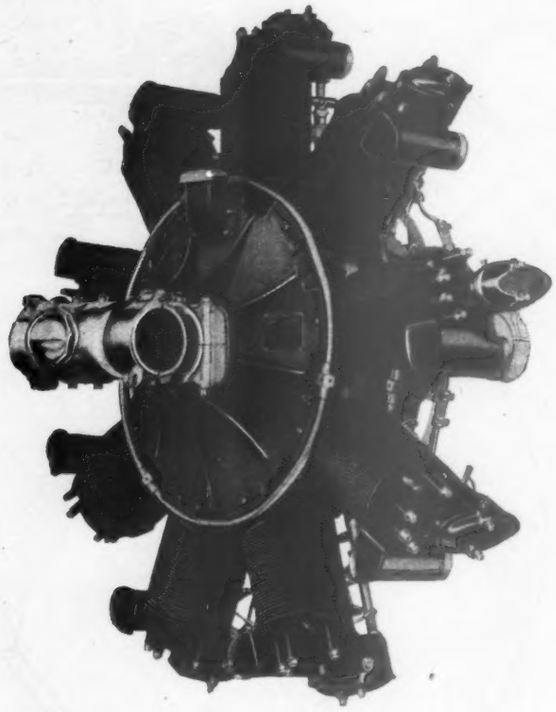
The shops of Govro-Nelson were among the first in America to signify complete understanding of these demands by the installation of production machines that work with almost human care, testing equipment that checks and re-checks with an accuracy of .0001" and a personnel that is both wise in experience and young in vision. ¶The experimental and production facilities of Govro-Nelson are used increasingly by aircraft engine manufacturers who are honestly striving for correctness of design and dependability while in flight.

THE
GOVRO-NELSON
COMPANY

1931 ANTOINETTE DETROIT

CRAFTSMEN TO THE AVIATION INDUSTRY

PACKARD-DIESEL



IMPROVED IN PERFORMANCE

Further perfection of the Packard-Diesel now gives a fresh "new impetus to flight." Through refinements it offers even greater advantages than ever before!

Today's Packard-Diesel will out perform *any* aircraft powerplant of equal horsepower rating. In all its performance characteristics—instantaneous acceleration—slow engine idling speed, in glide or dive—unfaltering smoothness—inherent reliability—and remarkable starting ease—today's Packard-Diesel is unexcelled.

In addition, the Packard-Diesel provides a host of exclusive advantages—safety from the fire hazard by its use of fire-safe fuel—freedom from radio interference by the very nature of its design. And its remarkable fuel economy has not only reduced operation costs but also it has increased payloads and extended the cruising radius of aircraft.

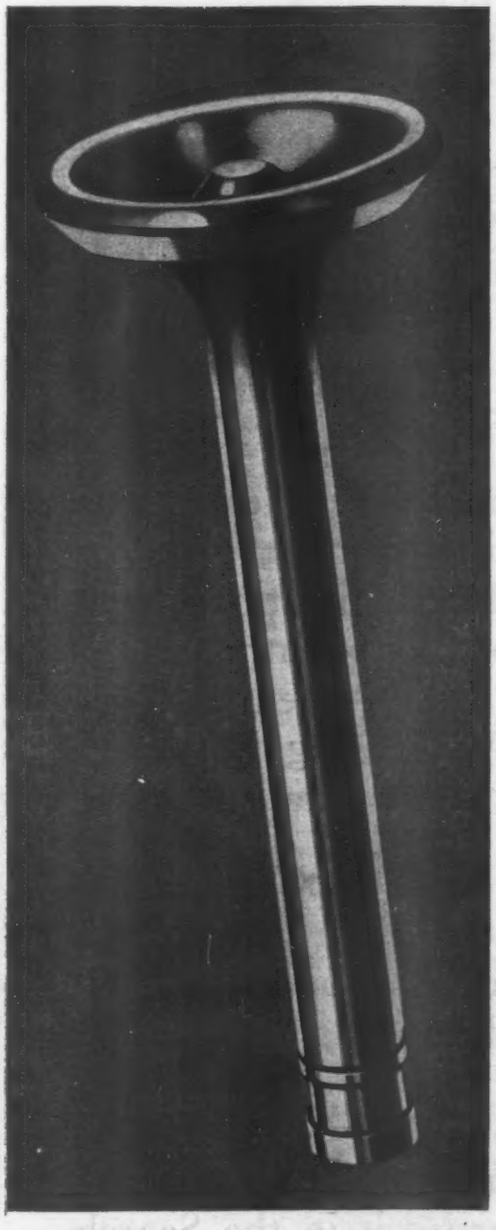
Since the Packard-Diesel was announced last April, installations have been made on practically all representative ships built in this country.

PACKARD MOTOR CAR COMPANY
Detroit

ASK THE MAN WHO OWNS ONE

FAMOUS FLIGHTS WITH THOMPSON VALVES

TO THE LAND OF THE KANGAROO IN THE *"Southern Cross"*



Thompson Valves

IN the judgment of air-trained men, no flight in history excels . . . in skill, daring and aeronautical importance . . . the brilliant achievement of Capt. E. Kingsford-Smith, Capt. C. T. P. Ulm, Lieut. Com. H. W. Lyon, Jr., and James W. Warner, with the "Southern Cross."

Leaving Oakland, California, on May 31, 1928, they covered the 7,800 miles to Brisbane, Australia, in less than 85 flying hours . . . with intermediate landings on the tiny islands of Honolulu and Suva, Fiji Islands.

Important contributors to the success of this famous flight were the 54 Thompson Valves in the 3 Wright Whirlwind motors of the "Southern Cross."

Such consistent dependability, in this and practically every other outstanding American flight since 1925, has influenced the adoption of Thompson Valves for America's finest aero motors.

THOMPSON PRODUCTS, INCORPORATED
General Offices: Cleveland, Ohio, U. S. A.
Factories: CLEVELAND and DETROIT

(This advertisement is one of a series recalling historic airplane flights in which Thompson Valves were used.)

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"Think SEARCHLIGHT First"

EMPLOYMENT : BUSINESS : **OPPORTUNITIES** : MACHINERY—USED OR SPECIAL

THE Searchlight Section of AVIATION offers a direct, quick-acting, and economical means of establishing contact with individuals and concerns throughout the aeronautical industry.

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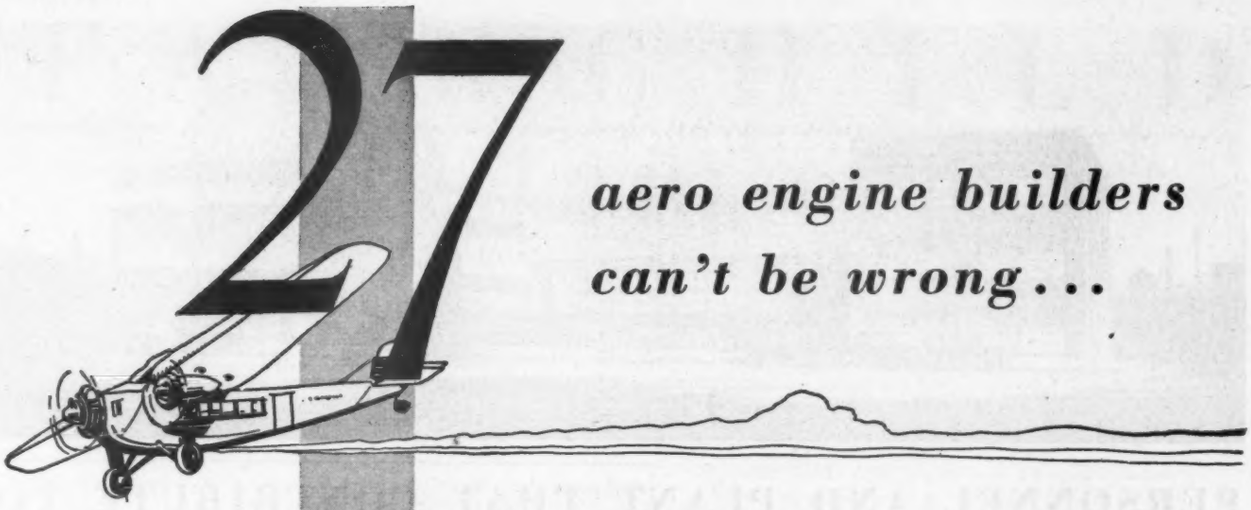
Based on many years' experience with classified advertising in McGraw-Hill publications, serving many of this country's major industries, the "Searchlight" Classified Advertising Service is complete in every detail.

When you want a job or need an employee, when you want to buy or sell used aviation equipment, if you need capital, have a field or plane for sale or have any other miscellaneous business want of interest to men in the aeronautical field—advertise it in the Searchlight Section of AVIATION for quick, profitable results!

SEARCHLIGHT DEPT.

Tenth Ave. at 36th St., New York City

27 *aero engine builders can't be wrong...*



They use Nickel Alloy Steel crankshafts because they...

"PERFORM BETTER LONGER"

NO other part of an airplane engine undergoes harder service than the crankshaft. It is a part for which material is specified only after thorough testing and research.

The fact that twenty-seven of America's leading manufacturers, building forty-five different airplane engines approved by the Department of Commerce, are unanimous in their choice of Nickel Alloy Steel crankshafts, is convincing proof of Nickel Steel's dependability. Many of the men who write American aircraft specifications also select Nickel Alloy Steel for gears, connecting rods, cams and other vital parts which contribute speed, comfort and safety to modern air transport. What better proof is needed that "Nickel Alloy Steel performs better longer"?

Our latest "Directory of Aircraft Engine Manufacturers" giving detailed engine specifications will be sent on request.

THE INTERNATIONAL NICKEL COMPANY, INC.
Miners, refiners and rollers of Nickel... Sole producers of Monel Metal
67 WALL STREET NEW YORK, N. Y.

These 27 airplane engine manufacturers use Nickel Alloy Steel crankshafts:

Aeromarine Plane & Motor Co.
American Cirrus Engines, Inc.
Chevolair Motors, Inc.
Chevrolet Aircraft Corp.
Comet Engine Co.
Continental Aircraft Engine Co.
Crosley Aircraft Co.
Curtiss Aeroplane & Motor Co.
Dayton Airplane Engine Co.
Fairchild Engine Corp.
General Airmotors Corp.
Jacobs Aircraft Engine Co.
Kimball Aircraft Corp.
Kinner Airplane & Motor Corp.
Lambert Aircraft Engine Corp.
LeBlond Aircraft Engine Corp.
Light Mfg. & Foundry Co.
Lycoming Manufacturing Co.
MacClatchie Manufacturing Co.
Menasco Motors, Inc.
Michigan Aero Engine Corp.
Milwaukee Parts Corp.
Packard Motor Car Co.
Pratt & Whitney Aircraft Co.
Szekely Aircraft & Engine Co.
Warner Aircraft Corp.
Wright Aeronautical Corp.

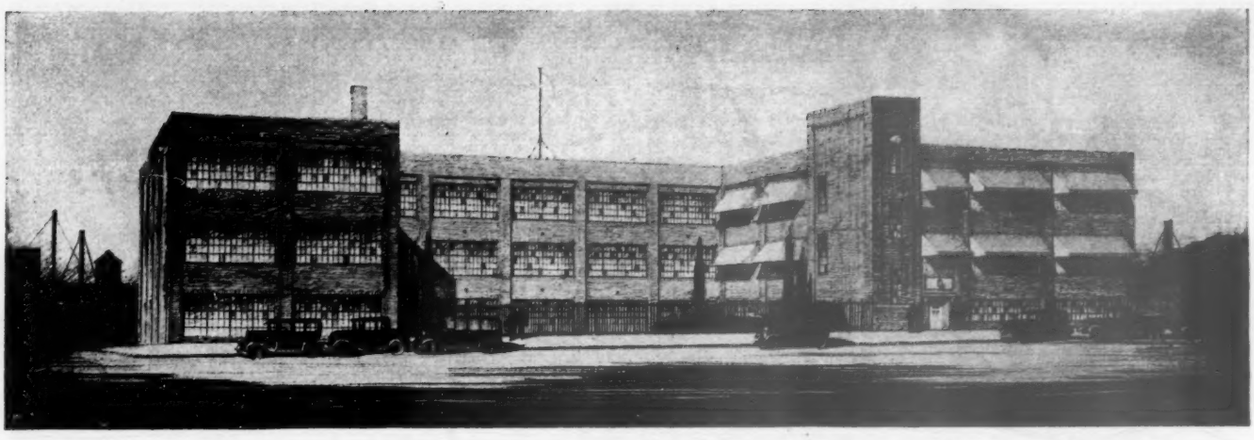
Dependable materials are the best assurance of dependable performance

(Upper right) *Nickel Alloy Steel crankshaft forging (unmachined) for V-type aviation engine.*

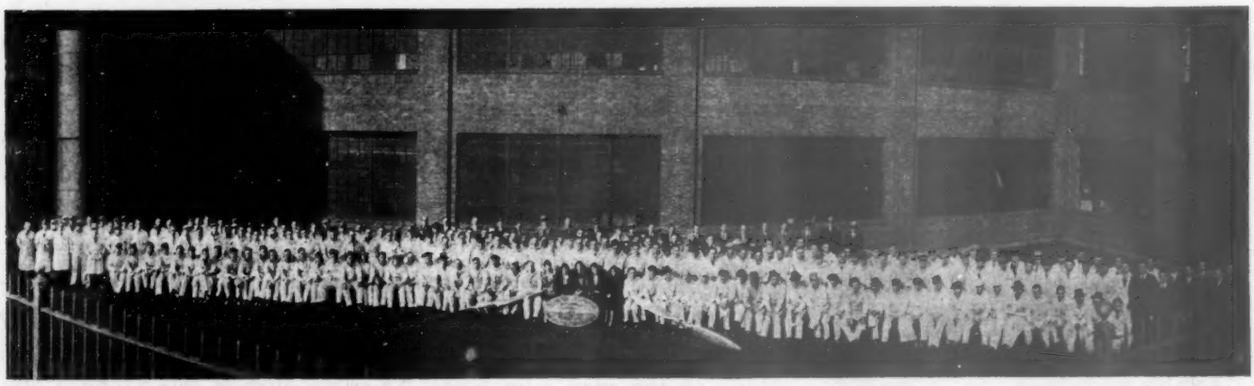
(Lower right) *Nickel Alloy Steel radial engine crankshaft.*

Ni NICKEL

Nickel
ALLOY STEEL
PERFORMS BETTER LONGER



PERSONNEL AND PLANT THAT CONTRIBUTE TO *PROVEN DEPENDABILITY*



In military, commercial and sport flying the Hamilton Standard trade-mark on metal propellers has come to stand for absolute dependability. Many factors have helped to build and maintain that reputation. Of these, personnel and plant are basically important.

The men who work on Hamilton Standard propellers must necessarily be something more than just good mechanics. Both blades and hubs involve painstaking hand shaping as well as accurately controlled machining. These men take as much pride in the contribution which the *dependability* of Hamilton Standard propellers has made to greater safety in air operations, as they do in the contribution which their *efficiency* has made in the more spectacular records for speed and altitude.

And the new and modern plant at Homestead is designed to give full expression to skill and craftsmanship. Plenty of light and air. The latest in machine equipment—much of it specially designed. A place vibrant with the will to produce perfect propellers, and pride in doing supremely well each step in the process from the preliminary inspection of incoming material to the last detail of final test.

HAMILTON STANDARD PROPELLER CORPORATION

PITTSBURGH, PENNSYLVANIA

DIVISION OF UNITED AIRCRAFT AND TRANSPORT CORPORATION

FAIRCHILD

AIRPLANES

Whether you are flying the largest transport or the smallest sport plane, your safety and satisfaction depend on quality.

Fairchild KR-21

FAIRCHILD AIRPLANES are all built to standards of quality—never to a price. That is why they have built new frontiers beyond the Arctic Circle in Canada and Alaska, and with Byrd in the Antarctic. They are regularly carrying the mail and passengers over the South American Andes, in Mexico and throughout North America, in the service of transport operators, the U. S. Army and Navy, the Canadian and other foreign Governments. You, too, will find PRIDE OF OWNERSHIP in their quality and rugged dependability.

New Prices

KR-21 Two place Sportster and Trainer, with complete equipment. Low pressure tires and brakes. Kinner 100 hp. engine. Flyaway..... **$3990.00**

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KR-34D Three place taxi, sport and training Biplane. Comet 165 hp. engine. Completely equipped. Flyaway Factory **$5675.00**

KR-34C Three place taxi, sport and training Biplane. Wright J-6 165 hp. Engine. Complete equipment and unusual performance. Flyaway, **$6200.00**

Slightly used factory demonstrators of all biplane and cabin models in excellent condition for sale at most attractive prices from $2200 upwards.

Full information upon request.

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Farmingdale, Long Island, N. Y.

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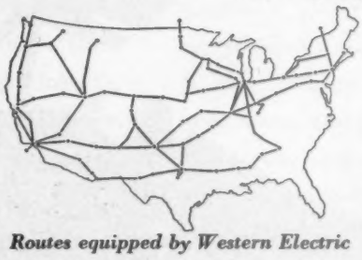
DIVISION OF THE AVIATION CORPORATION

Fairchild KR-34D

Fly straight as a homing pigeon

Fly your own ship 'cross country with unerring sense of direction, guided straight to your destination by Western Electric Airplane Telephone—the equipment selected by fifteen leading airlines.

By short wave radio telephone you talk with Western Electric equipped ground stations that dot the routes shown on the map. Over your long wave receiver you hear Government weather broadcasts and directional radio signals.



Routes equipped by Western Electric

You always know your true course and position—you always have up-to-the-minute information on flying and landing conditions ahead. No more losing your way over strange country—no more groping in clouds or fog.

Take advantage of these communication facilities — install Western Electric Equipment in your plane. Write for details to Western Electric Company, Dept. 251A, 195 Broadway, New York.

Western Electric

Aviation Communication Systems

MADE BY THE MAKERS OF BELL TELEPHONES

. . . . Pioneers!

EDO FLOATS

1926

1931

HUNDREDS of EDO Floats are in service today, among them the first models which EDO designed and manufactured in 1926. This record is practical proof that EDO all-metal floats, with their trim, staunch construction, ease of maintenance and years of service, have abundantly met the requirements of airplane manufacturers, transport operators and private owners. EDO Float installations, interchangeable with wheel landing gear, are licensed for use in the United States or Canada on more than 38 distinct types of land planes—more than all other makes of floats combined.

In EDO experience and engineering skill, aircraft manufacturers have at their prompt service a safe and sure means of solving all problems of float and flying boat hull design and construction. A letter will bring full particulars. Address, EDO Aircraft Corporation, 600 Second Street, College Point, Long Island, N. Y.

NOTE THESE POINTS OF EDO FLOATS

All metal construction.

Anodically treated against corrosion.

Will not swell, shrink or absorb water.

Water-tight bulkheads every 2 feet.

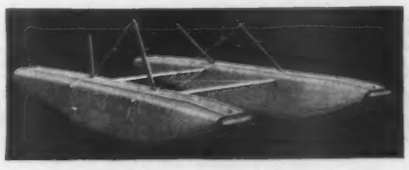
Patented fluted bottoms for quick take-off.

Heavy keels, shallow sterns for beaching.

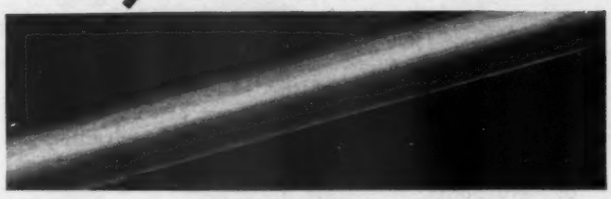
Flat decks for ease of taking on loads.

Wide sterns for perfect taxying.

Easy to install and overhaul.



STRENGTH in your Tubing



means

STRENGTH in your Airplane

SERVICE STEEL CO.

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Why BOEING TRAINING gives you a head start!

CAREER-PILOTS and the aviation mechanics of tomorrow are enrolling from all parts of the United States to obtain these advantages, offered all in one training only by the Boeing School of Aeronautics.

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4 Affiliation with Boeing System, operators of the San Francisco-Oakland-Chicago and Seattle-San Diego air mail-passenger lines, over which Boeing air mail pilots have flown 12,000,000 miles.

5 Individualized instruction. All-year flying conditions.

These are among the advantages you have by enrolling in America's best flying school, a University of the Air. Mail the coupon below today. Or write us about your plans for an aeronautical career.

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Division of United Aircraft & Transport Corporation

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Room 2-C, Airport, Oakland, California
Gentlemen: I am interested in

☐ Private Pilot
☐ Limited Commercial Pilot
☐ Transport Pilot
☐ Boeing Master Pilot
☐ Boeing Master Mechanic

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A NEW ENGINE for LIGHT PLANES

Very soon The Kimball Aircraft Corporation will announce a new engine—the result of careful research and experimentation—to meet the need for dependable power and assured performance in light aircraft.

Write for advance information.

THE KIMBALL AIRCRAFT CORP.
Naugatuck, Connecticut

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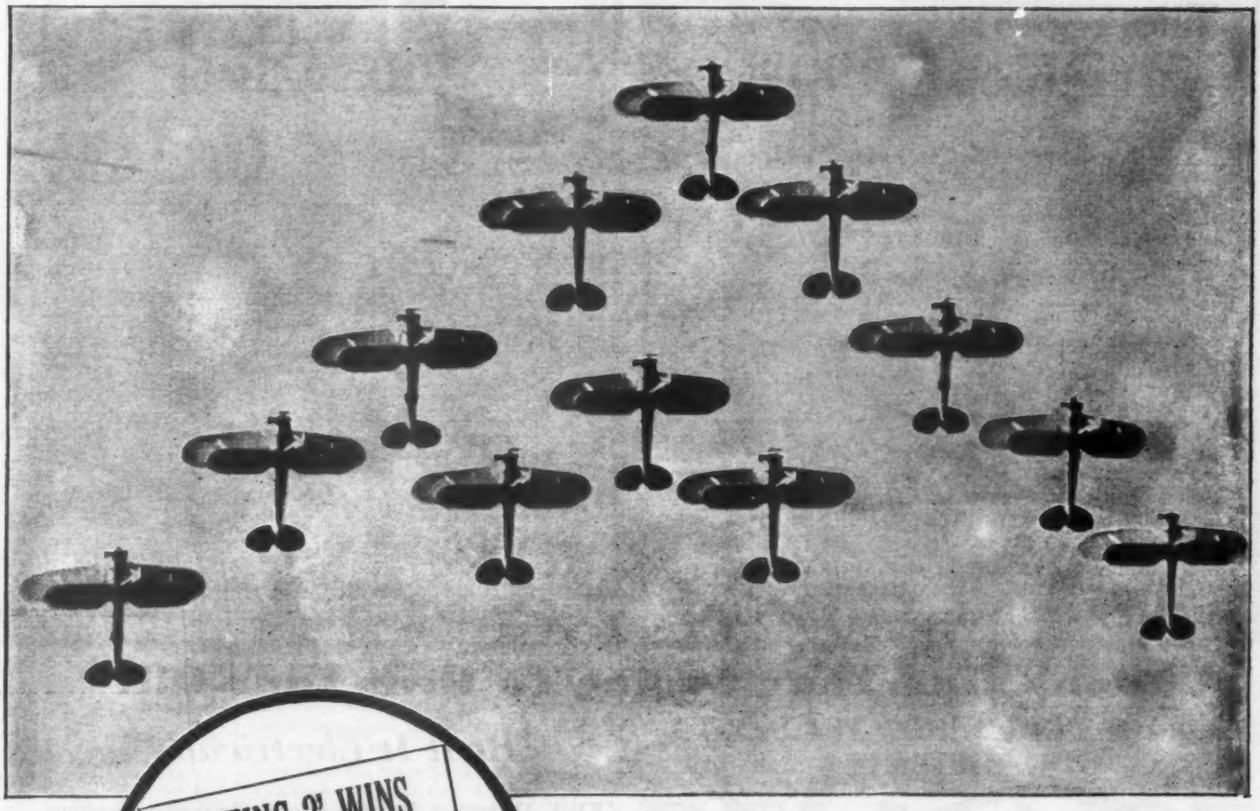
the equipment or machinery that you are not using. This may be occupying valuable space, collecting dust, rust and hard knocks in your shops and yards.

Sell it

before depreciation scraps it.

The Searchlight Section is helping others—
Let it help you also

..Another proof of BOEING QUALITY!



U.S. Navy Photograph

4,958 flying hours unmarred by accident and distinguished by remarkable aerial maneuvers! That record, set by the skilled pilots of the "Fighting Three," flying 18 Boeing fighters, won the coveted Schiff Memorial Trophy.

600,000 miles in close or open formations . . . 1500 hours over open seas . . . 861 take-offs from airplane carriers and the same number of landings, 18 planes landing considerably faster than one a minute . . . close wing and tail parade formations . . . dog fighting far aloft . . . 300-mile-an-hour dives from freezing altitudes.

Such performance is ordinary routine for Boeing fighters. For into them—as into every type of Boeing plane, military and commercial—is built stamina for the hardest jobs a plane can tackle. There is no substitute for Boeing quality.

BOEING
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SEATTLE, WASH.

A Division of the United Aircraft and Transport Corporation

[In Canada: Boeing Aircraft of Canada, Ltd., Vancouver, B.C.]

Manufactured Under
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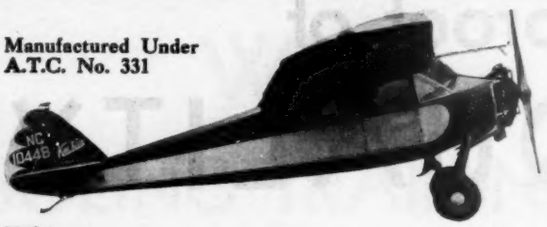

The Kari-Keen "90"

THE KARI-KEEN "90" is generally accepted as the most practical cabin monoplane designed for the school and private owner. Every desirable feature known to modern aircraft will be found in the KARI-KEEN without a single sacrifice of safety. Abundance of cabin room—the seat is as wide as the one in your car. Open ship visibility. Take-off and landing performance that will please the most critical pilot.

Equipment consists of Type "B" Consolidated Instrument Panel; Air Speed Indicator; Air Wheels and Brakes; Large and Convenient Baggage Space; Special Fahlin Propeller.

Price, $3365
Fly-away Factory

Write or wire for further particulars. Some territories available for 1931 to responsible operators.

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Successors to KARI-KEEN AIRCRAFT, INC.
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NORMA-HOFFMANN
PRECISION BEARINGS
for every
LOAD, SPEED, DUTY
(write for the catalogs)

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Don't Run Your Engine To Heat Your Oil!

Reaches Any Part of the Oil Tank

Heat It Electrically

THE Thermelex Flexible Electric Immersion heating unit, adaptable to any type of tank, will heat the oil so that your ship is ready to take the air with only a few moments warming up even in the coldest weather and in a cold hangar.

This will save hundreds of dollars of expense and wear and tear on your engine. Write for full particulars at once. Start your saving immediately.

GENERAL STORAGE BATTERY CO., 2005 LOCUST ST., ST. LOUIS, MO.

A Personal Want—

can invariably be filled by a friend.

The Searchlight Section

of this issue covers the current business wants of the industries in which this paper is read.

For Every Business Want
"*Think* SEARCHLIGHT *First*"

A Business Want—

must be satisfied by someone in your industry.

0134

PAGE FENCE in 4 Metals

There are sound economic reasons for 4 metals in fencing

J. Wallace Page, back in 1883, knew nothing of landing fields and hangars. But he did establish a business of building fence *intelligently adapted to conditions under which it is used.* And Page engineers have carried that principle into every modern condition.

Page H-Beam Line Posts of hot galvanized high carbon steel offer distinct advantages, but tubular posts are furnished where preferred.

Now there is Page Aviation Fence available in three different metals in Chain Link Fabric and Page Ornamental Refined Wrought Iron for administrative grounds and formal properties.

The right fence in one locality would be foolish extravagance in another. To make Page Fence last longer it is now made in these four metals, each the best for certain local atmospheric conditions—

1. **Page Alcoa Aluminum**
2. **Page Armco Ingot Iron**
3. **Page Copper-Bearing Steel**
4. **Page Ornamental Wrought Iron**

76 Service Plants erect PAGE Fence everywhere. Write for name and address of Plant in your locality. They will gladly consult with you and offer suggestions from plans to final erection. No obligation whatever. Complete descriptive literature on request. Address Page Fence Association, 520 North Michigan Avenue, Dept. E70, Chicago, Ill.

America's first —since PAGE *wire fence* 1883

PAGE

nation-wide service through 76 service plants

FENCE

Fence of Armco Ingot Iron fabric is exclusive with Page

Page Fence is a Product of The Page Steel & Wire Co., an Associate Company of American Chain Co., Inc.

CHAIN LINK OR ORNAMENTAL WROUGHT IRON

AGAIN WE EMPHASIZE ACCURACY

THE OUTSTANDING DEPENDABLE FEATURE OF

RELIANCE TACHOMETERS

ACCURACY—the "Reason Why" Reliance Tachometers are found on the Test stands of the majority of Airplane Engine Builders throughout the industry.

ACCURACY—the "Reason Why" Reliance Tachometers and Reliance Fittings are the usual Equipment on the finest types of planes.

ACCURACY-DEPENDABILITY-RELIABILITY—three "Reasons Why" you should select Reliance when Airplane Instruments are being specified.

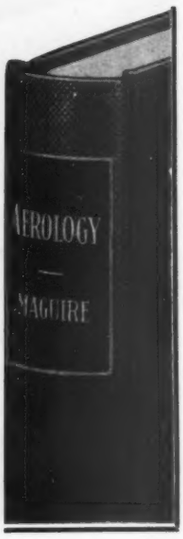
YOU CAN RELY ON RELIANCE.
Catalog sent gladly on request.

Barbour Stockwell Company
Cambridge, Massachusetts

Just Published!

A *practical manual of weather science for the aviator*

This book is planned to give the aviator and aviation student sufficient knowledge of meteorology to enable them to better determine flying conditions from their study of weather reports, forecasts and conditions.



AEROLOGY

A Ground School Manual in Aeronautical Meteorology

by CHARLES JOSEPH MAGUIRE
Lieutenant, United States Navy
Aerologist of the Bureau of Aeronautics
Navy Department

130 pages, 6 x 9, 31 plates, $2.50

THIS book presents a brief but accurate, non-mathematical discussion of the atmosphere. Its purpose is to tell the aviator how the weatherman works, how to interpret the weather phenomena the pilot sees around him and how best use may be made of the reports, advices, and forecasts which are now made available by specialists of long experience.

The book is thoroughly up-to-date and well illustrated, with maps and charts in colors. It discusses subjects of special importance in aeronautics, such as the effects of lightning on aircraft, ice formation, etc., and is of suitable length for the instruction in meteorology required by the Department of Commerce for transport pilot's license.

Chapter Headings

1. Weather Service and Information. 2. Weather Elements and Observations. 3. Construction of the Weather Map. 4. Distribution of Weather Elements over the Earth's Surface. 5. Relation Between Wind and Barometric Pressure. 6. Vertical Structure of the Atmosphere 7. Changes in Level of an Air Mass. 8. Condensation and Precipitation. 9. Cyclones and Anticyclones. 10. Strong Winds and the Thunderstorm. 11. Weather Forecasting. Appendix—Decoded Data for the Preparation of a Weather Map.

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Av. 2-31

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the equipment or machinery that you are not using. This may be occupying valuable space, collecting dust, rust and hard knocks in your shops and yards.

Sell it

before depreciation scraps it.

The Searchlight Section is helping others—
Let it help you also

GN-031

for dimensional accuracy and long life specify **RAYMOND SPRINGS**

Send us your inquiries for coil springs, flat springs, wire forms, and small stampings

RAYMOND MANUFACTURING CO.
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"Fortify for Fire Fighting"

The all round Fire Fighting Unit... Smothers fires in flammable liquids. The only safe extinguisher for electrical fires.

Pyrene
FIRE EQUIPMENT FOR EVERY HAZARD

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NEWARK NEW JERSEY
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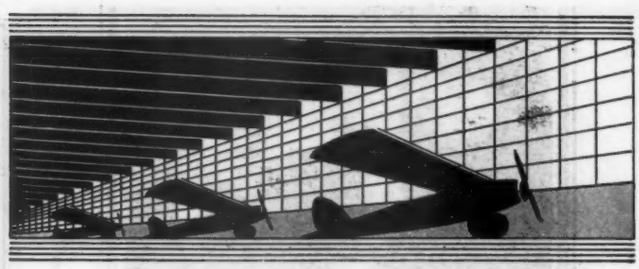


NATIONAL AIRCRAFT SHOW
of 1931

APRIL 11—19

SOLD OUT!

Every inch of the 200,000 square feet of exhibition space available for the National Aircraft Show of 1931 has been sold! Never before in the history of any aircraft show has space been taken so rapidly — and so far ahead of the opening!

This year the National Aircraft Show is the only aeronautical exhibition of importance to take place anywhere in the United States. Being held at the Detroit City Airport and Hangar it will have a setting that is absolutely unmatched for show and demonstration purposes. From April eleventh to nineteenth the Show will be the center of interest for everyone connected with the aviation industry.

With success already assured by the large number of manufacturers who have definitely signified their intention of exhibiting, the National Aircraft Show promises to be the greatest event of its kind in the annals of aviation. The Aeronautical Chamber of Commerce of America, Incorporated, and the Aircraft Bureau of the Detroit Board of Commerce as co-sponsors of the Show, wish to thank the entire aviation industry for the enthusiastic support it has given this exhibition

For information write to

RAY COOPER, Manager
Aircraft Bureau,
Detroit Board of Commerce,
Detroit, Michigan

"Won't you please sit down, Mr. Dealer . . . *Let's talk things over."*

"If we're real frank with ourselves, I think we'll both admit that we're damglad to see a new year under way, with brighter prospects and fresh hopes.

"The question is, what are we going to do about it?

"So far as we're concerned, we're sticking by our guns here at Troy. We pulled through 1930 with what is, under the conditions, a very satisfactory showing. That is because we refused to be stampeded into excess production during 1929, had no surplus production to carry over either at the plant or in the hands of distributors, and could proceed with the new Model F and the other 1930 WACO developments without any millstone of 1929 airplanes to load us down.

"We never have—and we won't—high-pressure our distributors into excessive commitments.

"We never have—and we won't—undersell our own dealers to dispose of surplus stock labeled as 'demonstrators.'

"We have found that our own profits are conserved by putting the interests of our distributors *first* in fixing our policies. It pays us—just as it pays them. And for the same reasons.

"That's why 1930 has been a quite satisfactory and profitable year for most of the WACO family—and why 1931 will be even more so. Some territory is still 'open'. But it won't be long now!

"What do *you* say? Can we help each other to greater profits in 1931?"

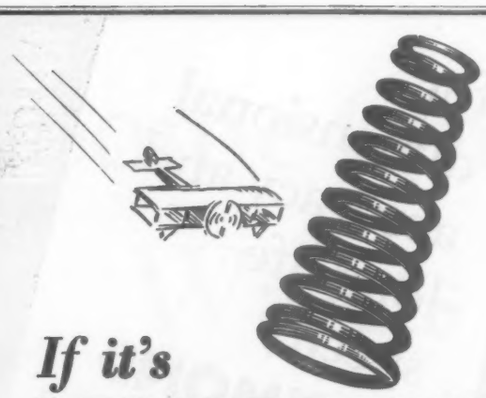
Sales Manager

THE WACO AIRCRAFT COMPANY, Troy, Ohio.

WACO AIRPLANES

"ASK ANY PILOT"

0-29



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. . . to keep your Production Lines on the move, Barnes-made Springs have been building a reputation for dependable service for years. Won't you tell us your spring requirements . . . one or a million?

The Wallace Barnes Co.

BRISTOL, CONN., U. S. A.

A NEW TYPE AIRCRAFT RECEIVER

THE Model D Stromberg-Carlson Aircraft Receiver adds new *safety* and dependability to flying operations. It is designed for aircraft reception of radio range signals, weather reports and all other radio aids to *safe* flying. Interchangeable Coil Sets make this instrument adaptable to the entire radio spectrum.

A particularly favorable signal-to-noise ratio, accompanied by high sensitivity and selectivity, is its outstanding electrical characteristic. Extreme simplicity of construction, together with the ease with which Model D may be controlled, appeal to both the aeronautical engineer and the radio technician.

Let us send complete details of the new Model D Stromberg-Carlson Aircraft Receiver.

Stromberg-Carlson Telephone Mfg. Co., Rochester, N.Y.

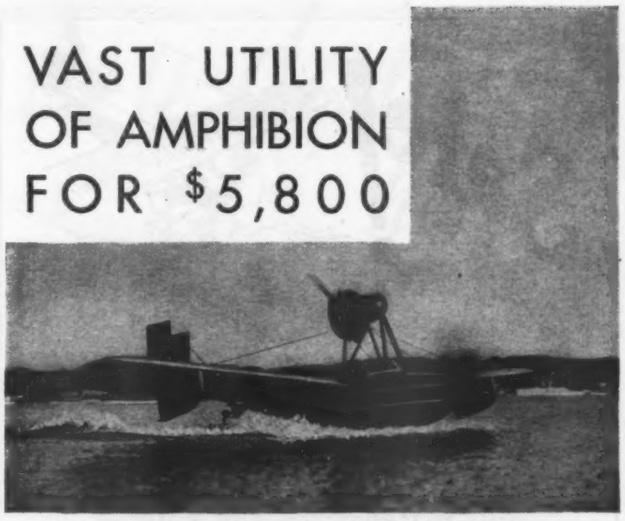
Address all inquiries to our Sales Representative: Aircraft Radio Corporation, Boonton, N. J.

Model D Stromberg-Carlson Aircraft Receiver equipped with Eveready Raytheon 4-Pillar Tubes and powered by Eveready Dry Batteries. Over-all Dimensions of Receiver and Mounting Base: 16½ x 9½ x 9¼ inches. Weight: 18 pounds. Licensed Under: A. T. & T. Co., R. C. A., R. F. L. and Aircraft Radio Corp. Patents.

Stromberg-Carlson

Makers of Voice Transmission and Voice Reception Apparatus For More Than Thirty-Five Years

VAST UTILITY OF AMPHIBION FOR $5,800



PRIVATEER landing . . . no spray for passengers. Notice wheels tucked under wings.

PRIVATEER!

PRIVATEER brings to the three great air minded classes . . . flying schools, sportsmen and salesmen . . . the utility and safety of an amphibion at a price several thousand dollars under that of current amphibion costs. PRIVATEER'S price of $5,800 makes it the lowest priced amphibion in the world.

Designed by pioneer makers of amphibions . . . proved service worthy by stiff tests . . . the two place open cockpit PRIVATEER (A. T. C. 370) adapts itself to every conceivable flying and landing condition with a maneuverability that amazes experienced pilots. Combines ease of control with remarkable stability, smart appearance and the *dual safety* and *dual pleasure* of land and water. Flying range adequate for all reasonable needs . . . motor parts extremely easy of access.

A dependable Warner "Scarab" motor of 110 h. p. provides a high speed of 95 miles per hour . . . a cruising speed of 75 . . . a landing speed of 41 . . . a climb of 650 feet per minute . . . a cruising range of 250 miles. All this with a useful load of 600 lbs. . . . performance aplenty!

Naturally, because of its wide utility and low maintenance cost, dealers who sell the PRIVATEER have entry into a vast and comprehensive aviation market. Three other models in the Amphibions, Inc. fleet furnish an amphibion for any purse . . . and the Amphibions, Inc. dealer policy provides a liberal margin of profit on each sale.

For complete information concerning the territorial appointments which are now being made, write

PRIVATEER
$5,800 (Fly-away at Factory)
A. T. C. 370
Weight Empty, 1350 lbs.
Gross Weight, 1950 lbs.
Standard Equipment
Warner "Scarab" 110 h. p.
Wood Pusher Propeller
Heywood Injection Starter
Low Pressure Tires
Fuel Level Gauge
Tachometer
Oil Thermometer
Air Speed Indicator
Altimeter, Tools, Anchor
Rope, Cockpit Cover
Fire Extinguisher

AMPHIBIONS, INC.
(FORMERLY IRELAND AIRCRAFT, INC.)
GARDEN CITY NEW YORK

Experience

For nearly fifty years The Zapon Company has been outstanding in the manufacture of

PYROXYLIN LACQUER

The experience of half a century is an ingredient in every formula of Zapon Products.

ZAPON
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THE ZAPON COMPANY
A Division of Atlas Powder Company
STAMFORD, CONN.

the UNIVERSAL PRODUCT

Consider this most versatile product when confronted by difficult engineering problems. The diversified uses it readily lends itself to are really amazing.

The largest manufacturers of felt in the world, the American Felt Company, maintains a staff of experts anxious to co-operate with you in the solving of difficult situations.

Felt may be cut to exacting standards or supplied in bulk. It is most durable.

Send the coupon today—it will effect prompt action.

American Felt Co.

NEW YORK BOSTON SAN FRANCISCO DETROIT
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AMERICAN FELT CO., 315 FOURTH AVENUE, N. Y. C.
We are interested in the use of felt.
Send sample for _____
☐ Have your representative call.
Name _____
Address _____
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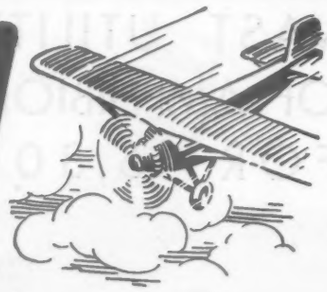

Safe!

Where there is no landing there must be no failure

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1800 Clybourn Avenue . . . CHICAGO, ILL.
Send for our Catalogue

The unvarying dependability of Williams' Aircraft forgings results from efficient laboratory analyses of material and direct supervision of the various manufacturing processes by a competent metallurgical staff.

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Any shape, any material and any size up to 350 lbs.

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Made of copper-steel, heavily galvanized; erected on H-column posts. Every installation guaranteed to be satisfactory.

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SUBSIDIARY OF
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Cyclone—not a "type" of fence—but fence made exclusively by Cyclone Fence Company and identified by this trademark.

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In the airplane industry, highest grades of materials insuring top efficiency are expected and demanded. So when it comes to solder—Kester meets this demand.

It even exceeds the purity requirements of the A. S. T. M. for Class A alloy.

Kester carries scientifically designed flux *inside itself.* And because the combination of flux and solder is always correct—Kester puts a quick stop to soldering failures.

It stops 50% waste in time, labor and materials. It will cut soldering costs in half and double efficiency. It makes for *uniform* soldering results.

Get our help *now* in solving your soldering problems and reducing production and maintenance costs. There is no obligation at all. Write *today.*

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4263 Wrightwood Avenue Chicago, Ill.
Incorporated 1899

KESTER FLUX-CORE SOLDER
Acid-Core · Paste-Core · Rosin-Core

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EAGLE OTTAWA

Can be washed with soap and water

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Don't Crack
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Good Take Up
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These essential qualities of good dopes are demanded by experienced aircraft manufacturers. That they are inherent in PERRY-AUSTEN DOPES has been proven by Government and manufacturers' laboratory tests and in practical service on thousands of military and commercial aircraft.

PERRY-AUSTEN DOPES are produced by the oldest manufacturer of aircraft dopes in the United States and they are used by many of America's foremost aircraft manufacturers. Ask for our quotations, whether for large or small quantities.

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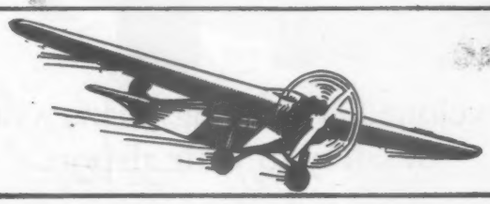

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AIRPLANE SPRINGS

on a production or experimental basis

"Two Plants for Spring Service"

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6400 MILLER AVENUE

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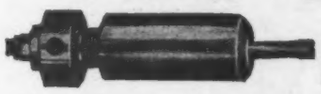
BARNES-GIBSON-RAYMOND-INC

AIRCRAFT SERVICE DIRECTORY

TAIL SKID FOR WACO, BIRD, ETC.
BEST SILICON MANGANESE STEEL
$2.95

TAIL SHOES
EXTRA HARD MANGANESE STEEL
FOR WACO BIRD AM EAGLE 85¢
FOR TRAVEL AIR EAGLE ROCK ETC 2.50



THIS VALVE-GUIDE PULLER

$5.00 Extracts Tight Guides on Kinner, Lambert or Warner engines, no heat, no fuss, no other tools required.

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Rough Green-Kiln Dried Rough-Air Dried or Finished to your sizes. Prompt shipments in carloads and less than carloads. We supply many of the largest manufacturers in the United States and Europe.

Specialists in Airplane Spruce since Aviation started

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AVIATION

Burgess-Norton Piston Pins stand severe punishment unflinchingly. They are precisely made of finest materials. Every one is perfectly lapped and guaranteed.

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Contract Work to Your Specifications

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"What's it worth to you?"

A familiar expression—generally associated with bargaining. But it has other applications: For instance, the advertising on this page: "What's it worth to you?" Not in terms of dollars-and-cents immediate profit, but in the service rendered in acquainting you with specialties, special services, accessories, materials and parts of special interest to the aviation industry.

Some items pertinent to aircraft building and operation are of small unit price, limited application or subject to other restrictions that do not economically justify prominent advertising. They are accordingly offered for your consideration through the card advertisements on this page. The extent to which you are thereby served—not the size of the cards—is the gauge of "What's it worth to you?"

Make it a habit to check the card advertisements of the Aircraft Service Directory each issue to derive the greatest benefit from this service.

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(Patented)

Saws Wood or Metals

Complete Portable Universal Saw

For Aeronautical Work
STATE MFG. & ENG. CO.
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One and Two-way outfits, for instruction or cross country. Used with or without your own helmet, no cutting or fitting. Fittings provided for plugging in each cockpit. The most practical outfit yet offered regardless of cost. Further details on request.

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MAGNETIC
FUEL GAGES FOR AIRCRAFT
NEW MODELS FOR COWL, WING, OR SPECIAL TANKS
Manufactured by
THE BOSTON AUTO GAGE COMPANY
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THE NEW NB4
ALL METAL STRUCTURED

NICHOLAS-BEAZLEY AIRPLANE CO. Inc.
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Skyleader Compass

Most reliable and trustworthy instrument, aperiodic, fully compensated, easily adjusted, new type extra light weight card, jeweled, cobalt steel magnets.

Worth $62.50
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Brand New

Bosch BOOSTER

Extra powerful spark will start the most stubborn motor in cold weather. Complete brand new, was $20.

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To warm the oil right in your tank, just plug in—in 20 minutes your motor is ready to fly. In ordering specify motor, type of airplane and size of drain plug.

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to check valve clearance on all aircraft motors. 7 leaves .005", .010", .012", .015", .020", .030", .040", 6" long. Ends bent 45°.
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AIR TRANSPORT EQUIPMENT INC.
Garden City, N. Y.

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LINDBERGH FIELD, SAN DIEGO, CALIFORNIA
Send For Complete Information
Department of Commerce Approved Transport Ground & Flying School

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MAPS YOUR ROAD TO FAME AND FORTUNE

This book is a complete guide to success in aviation. Until you've read it, you can't intelligently plan your career. "Skyward Ho!" describes and pictures the world's largest commercial flying school; discusses aviation's future, and the training which prepares you to take your place in the great development 1931 will bring.

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Section 2-AV, Parks Airport
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EAGLE AIRWAYS
P. O. Address Hinckley, Illinois, 50 miles West of Chicago

Learn to Fly at our new location, on the Transcontinental Airways; DeKalb County Airport. Equipped for night flying, good equipment, Transport Pilots and excellent accommodations. Very reasonable rates. Distributors for Stinson Monoplanes, Monocoupes. Write for free information.

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Save time and money by taking the Tri-State College course in Aeronautical Engineering, 102 weeks. Bachelor of Science Degree. Graduates in Mechanical Engineering can complete course in two terms (24 weeks). Thorough training in all fundamental engineering subjects. Non-essentials eliminated. Courses designed to save student time and money. Flying school facilities available at nearby airports. Enter September, January, March and June. College now in 47th year. Courses are offered in Civil, Electrical, Mechanical and Chemical Engineering. Also Business Administration and Accounting. Living costs and tuition low. Those who lack high school may make up work. Graduates successful.

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The Western Air Service Corporation

Transport Course	$2250
Limited Commercial	775
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One of the largest fleets of air cooled licensed ships operated in the Middle West for school purposes only. Wire or write today.

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Good Pay in Aviation! Learn at Lincoln—where "Lindy" learned. Government Approved. Factory in connection. Part time employment. Write for details.
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U. S. GOV. APPROVED SCHOOL
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AGENTS FOR: Waco Stinson Loening Fleet Travelair
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Complete ground instruction under Government licensed experts; 4-6 month course depending on how fast student completes required work. Theory and practical shop work on latest planes and engines including Wright Whirlwind. Build complete ships. Valuable foundation for well-paid positions—flying and ground. Day or evening. Easy terms.
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Transport Pilots Course
$2500.00

U. S. Government Approved School
202 Hours' Flying Time
on WACO-F, bi-planes, FAIRCHILD Biplanes with Warner and Kinner motors, FAIRCHILD mono with Wright Whirlwind J-5, Curtiss Robin mono, Challenger biplanes. FORD TRI-MOTOR 12 pass. mono. Flying from NEPCO's mile square airport.

Write for full information

NEPCO TRI-CITY FLYING SERVICE, INC.
MAJOR LESLIE G. MULZER, Vice Pres.
WISCONSIN RAPIDS, WIS.

THE "WHERE TO FLY" SECTION IS ARRANGED GEOGRAPHICALLY FOR YOUR CONVENIENCE. LEADING SCHOOLS THROUGHOUT THE COUNTRY ARE REPRESENTED IN THIS SECTION. SELECT YOUR SCHOOL FROM THIS CONVENIENT GUIDE.

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Gasoline and Oil Engines Exclusively
DESIGNS *and* CONSULTATIONS
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Discount of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

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1 inch.....$6.00
2 inches..... 5.75 an inch
4 inches..... 5.50 an inch

Other spaces and contract rates on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

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WANTED: A connection is available for an aerial photographer with camera. Write for details. H. A. Muneke, 1304 Hamilton, Allentown, Pa.

WANTED transport pilot with a ship to operate or lease, one of the best paying airports in the state, with picnic grounds. Student training. H. Kohler, St. Charles, Ill.

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AERONAUTICAL engineer. Active experience in creative design, stress analysis and management since 1914. Successful record in designing and engineering planes for military and commercial purposes. Now in New York district. PW-49, Aviation, Tenth Ave. at 36th St., New York.

AREONAUTICAL engineer, University of Michigan graduate, six years experience in airplane design, stress analysis, and areodynamics. Formerly with Air Corps and various airplane manufacturers. Best references. PW-55, Aviation, 520 No. Michigan Ave., Chicago, Ill.

EXPERIENCED railroad train dispatcher (twelve years), desires similar position aviation company. Employed past eight years office engineer State Highway Department. References. E. C. Evans, Box 628, Pocatello, Idaho.

LICENSED repair man—technical and business experience. Expert workman. Experienced on modern planes and motors. Sober, dependable, can make money and friends. Go anywhere. PW-59, Aviation, 520 No. Michigan Ave., Chicago, Ill.

PILOT-ENGINEER, transport pilot, U. S. Navy trained, 700 hours, open and closed planes. Experienced in instruction, cross-country, and experimental engine flight testing. Graduate aeronautical engineering, University of Michigan. Will accept any reasonable offer, engineering or flying. Best references, age 24, single. PW-51, Aviation, 520 No. Michigan Ave., Chicago, Ill.

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TRANSPORT pilot, 325 hours. A-1 rating. Experienced instructor and cross country flyer. References furnished. Emmett Kyle, Stanley, Wisc.

TRANSPORT pilot, 1,400 hours; will work cheap as co-pilot to get multi engine rating; now employed on passenger line. PW-58, Aviation, 520 No. Michigan Ave., Chicago, Ill.

TRANSPORT pilot; 8 years experience in all types. Licensed airplane and engine mechanic. Over 2,500 logged hours. Experienced operations and service chief. Best references from past employers. PW-56, Aviation, Tenth Ave. at 36th St., New York.

TRANSPORT pilot, experienced cross-country, passenger and instruction work, 500 hours; open and cabin ships, finest references; age twenty-five. PW-20, Aviation, Tenth Ave. at 36th Street, New York.

YOUNG woman, 21, single, college training, private license, mechanical training, excellent references. Will go anywhere. Mary Hamilton, Detroit Lakes, Minnesota.

MISCELLANEOUS

AIR stamp collecting, the ideal hobby for all interested in flight. Illustrated priced catalogue and guide, 70 cents postpaid. Air stamps sent on approval. Stanley Gibbons, Ltd., Dept. 124, 391 Strand, London, England.

PHOTOGRAPHS of airplanes, all makes, 7 x 10 heavy weight, 3 for dollar, C.O.D. Send for Special Offer. John Stiles, Stoughton, Mass.

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COMPLETE plans for two place plane powered with new 60-hp. Ford motor, $3.00 per set. A. Breuer, Sheridan, Ill.

BUSINESS OPPORTUNITIES

CORPORATE, organizing and promoting of meritorious enterprises, reorganizations, mergers and new financing. The Brookworth Company, Inc., 110 East 42nd St., New York City.

EXPERIENCED engineering group desires connection with well financed company or finance for newly developed project. Have 4 A.T.C.s. BO-50, Aviation, Tenth Ave. at 36th St., New York.

Will Exchange Vacant Property

In Dearborn, Michigan, with taxation value of $1,000 and $500 cash for airplane. Alfred Tyrrell, 1309 Wayburn Ave., Detroit, Mich.

Partner Wanted in Aircraft Repair Business

Am making money but want to expand to be able to take care of summer increase in business. BO-52, Aviation, Tenth Ave. at 36th St., New York.

FOR SALE

A CURTISS JN4D with OX-5 and Curtiss-Reed steel propeller. New magneto and carburetor. Good condition. Price $375, or offer. Chas. J. Happ, Doylestown, Pa.

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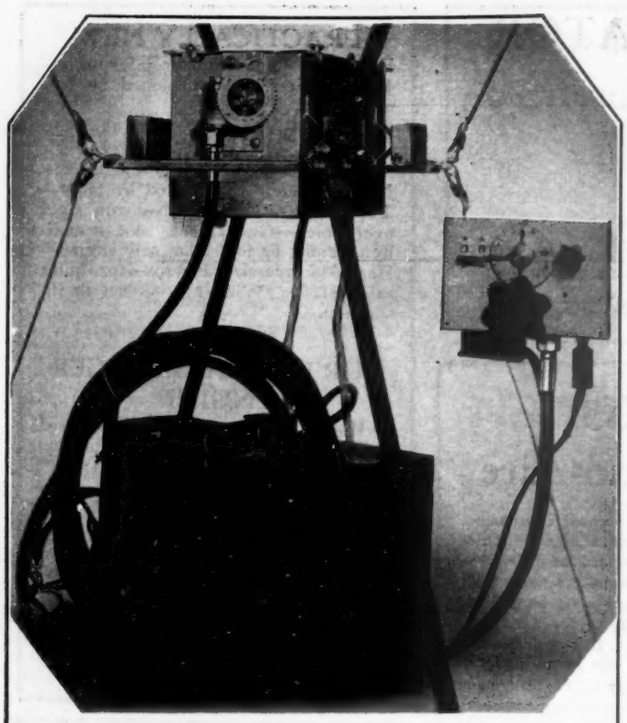

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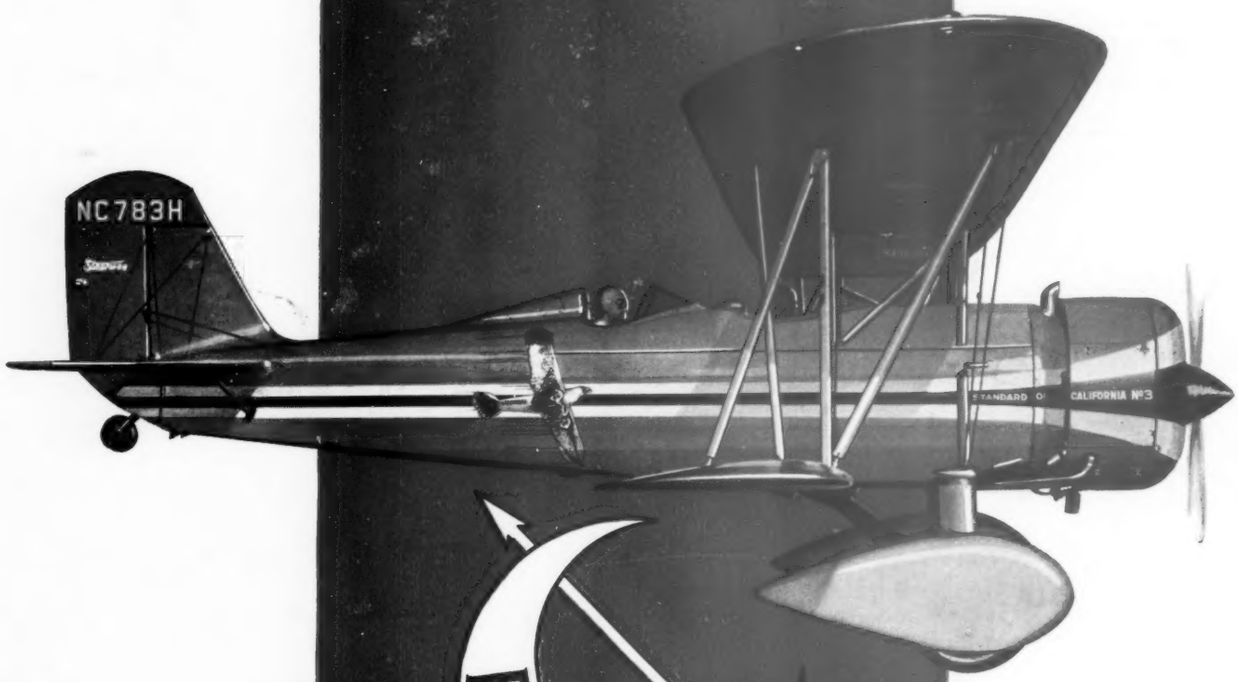

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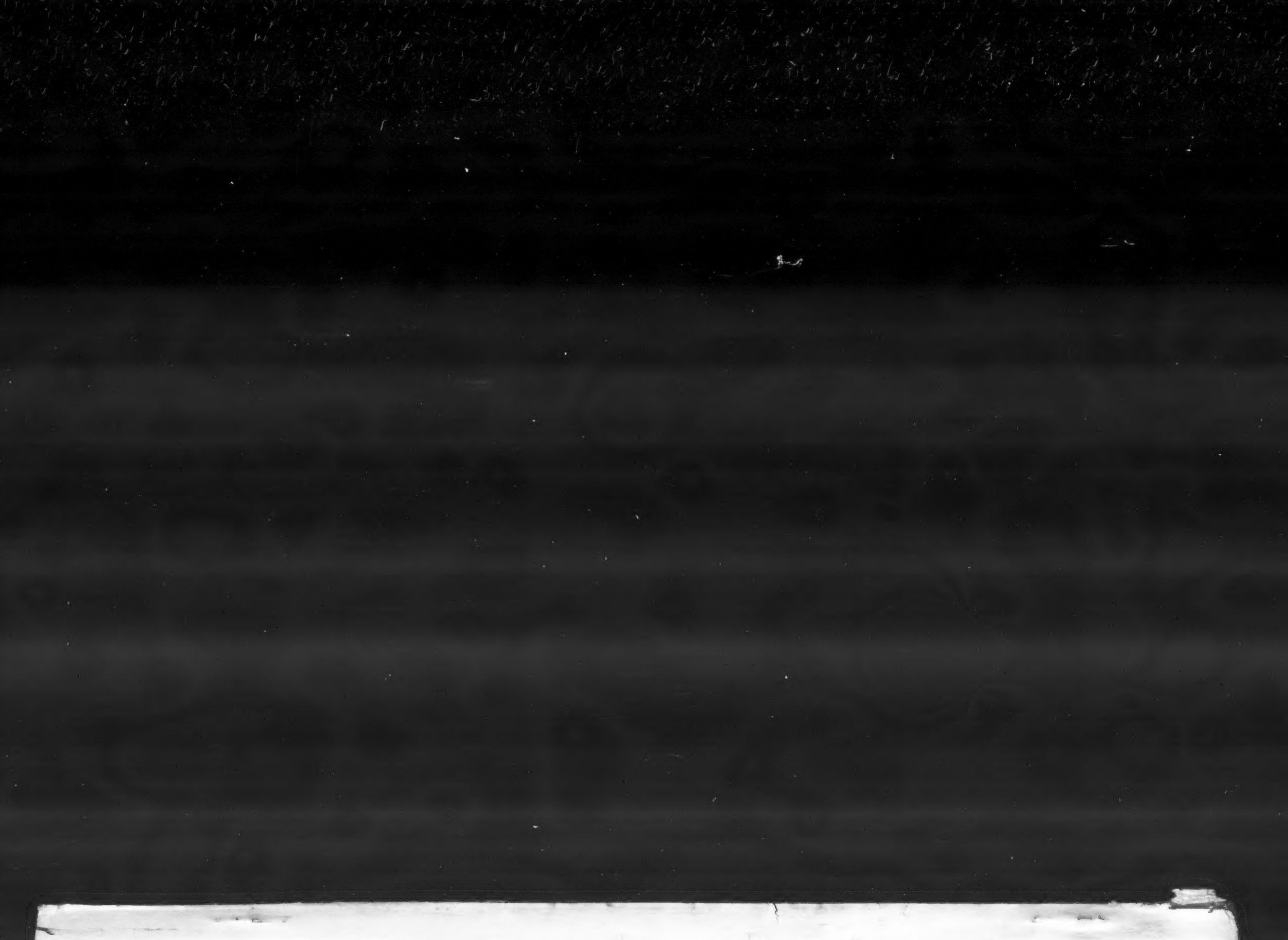
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